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# ABSTRACT BOOK

# Oral Presentations

## *Pediatric Topic*

## NRF2 immunohistochemical expression in stillbirths: a potential marker of hyperacute fetal hypoxia

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**Introduction**. Nuclear factor erythroid 2–related factor 2 (NRF2) is a transcription factor activated by oxidative stress, regulating cellular antioxidant responses. Recent forensic studies demonstrated increased nuclear NRF2 expression in acute ischemic myocardial injury, supporting its potential value as an early postmortem marker of hypoxia [1]. Furthermore, molecular forensic investigations highlighted the involvement of NRF2-related pathways in different death processes characterized by oxidative stress and environmental insults [2]. However, the possible forensic role of NRF2 in perinatal pathology and stillbirth investigation has not yet been explored. The aim of this study was to evaluate NRF2 immunohistochemical expression in a cohort of stillbirths and to assess its association with acute fetal hypoxic events.
**Materials and Methods**. A retrospective forensic study was performed on 42 stillbirth cases undergoing complete autopsy at Azienda USL–IRCCS di Reggio Emilia, Italy, between 2017 and 2024. Clinical and circumstantial data, gestational age, fetal sex and weight, delivery characteristics, macroscopic and histopathological findings of fetus and placenta, timing of fetal distress (acute <6 h, subacute 6–24 h, chronic >24 h), and estimated death-delivery and death–autopsy interval were reviewed. Immunohistochemical analysis for NRF2 was performed on fetal tissues, and cases were classified as positive or negative based on nuclear immunoreactivity. Associations between NRF2 expression and cause of death were evaluated.
**Results**. NRF2 positivity was observed in 9/42 cases (21.4%), whereas 33/42 (78.6%) were negative. Most stillbirths occurred in the third trimester (33/42, 78%) while 9/22 cases (22%) were in the second trimester.
Among NRF2-positive cases, acute or hyperacute hypoxic conditions were prevalent, including placental abruption (3/9) and cord-related accidents (6/9), such as true knot, cord thrombosis, and tight nuchal loops. NRF2 positivity clustered predominantly in cases showing acute or subacute fetal distress patterns, whereas NRF2-negative cases were predominantly associated with subacute-chronic distress and chronic placental pathology. Histopathological findings consistent with recent hypoxic injury were more frequently observed in NRF2-positive cases, while chronic placental insufficiency, delayed villous maturation, and long-standing fetal vascular malperfusion were mainly found in NRF2-negative cases.
**Conclusion**. Our findings suggest that NRF2 immunohistochemical expression may represent a promising adjunctive marker of hyperacute fetal hypoxia in stillbirths. Consistent with previous forensic and molecular pathology studies demonstrating NRF2 activation in oxidative stress–related death processes, NRF2 expression in fetal tissues may reflect an early cellular response occurring before overt morphological changes become evident [1,2]. Considering that accurate estimation of the timing of fetal death remains a major challenge in forensic perinatal pathology, NRF2 immunohistochemistry may represent a complementary

tool within the multidisciplinary postmortem assessment currently based on macroscopic and histopathological evaluation [3].

Further studies on larger cohorts are needed to validate its diagnostic utility in forensic perinatal pathology.

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## Myoglobin immunohistochemistry for the study of the fetal cardiac conduction system: applications in sudden unexplained intrauterine death

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**Introduction**. Sudden unexplained intrauterine death (SIUD) represents one of the most challenging entities in gynecological, pediatric, and forensic pathology. Despite advances in prenatal diagnostics, fetal monitoring, and postmortem investigations, a substantial proportion of fetal deaths remain unexplained after comprehensive clinical, histopathological, and genetic evaluation. In high-income countries, SIUD accounts for up to 30–50% of fetal deaths, with significant clinical, psychological, social, and medicolegal implications. SIUD is defined as fetal death occurring in utero without identifiable causes after complete diagnostic workup, distinguishing it from deaths related to maternal, placental, fetal, infectious, or traumatic conditions. Among the proposed pathogenic mechanisms are subclinical placental dysfunction, fetal arrhythmias, genetic and metabolic disorders, and immunological factors. Abnormalities of the cardiac conduction system are of particular interest, drawing parallels with sudden infant death syndrome (SIDS).

**Materials and Methods**. This study included 28 cases of fetal and perinatal death (2023–2026) examined at the Pathology Unit of the University Hospital "Città della Salute e della Scienza" of Turin. All cases underwent complete autopsy with histological examination of fetal organs, placenta, and umbilical cord. The cardiac conduction system was systematically sampled and analyzed using routine hematoxylin-eosin (H&E) staining and immunohistochemistry for myoglobin, desmin, and myogenin. Findings were correlated with gestational age, clinical history, and final diagnosis.

**Results**. Desmin and myogenin showed no selective immunoreactivity in conduction tissue at any gestational age, limiting their usefulness in distinguishing conduction myocardium from working myocardium. In contrast, myoglobin demonstrated a distinct and reproducible expression pattern. A subendocardial-to- subepicardial gradient was observed during fetal life, with marked positivity in the atrioventricular node and adjacent conduction pathways. Immunohistochemical images obtained with myoglobin were immediately interpretable, allowing rapid and clear differentiation between atrioventricular conduction tissue and surrounding non-conducting myocardium. This distinction was particularly evident when compared with H&E-stained sections from the same samples, in which identification of conduction tissue required more detailed morphological assessment and greater operator expertise. The differential expression of myoglobin in conduction myocardium may not represent merely a phenotypic marker. Experimental murine studies have suggested a potential role for myoglobin in cellular differentiation and metabolic regulation during cardiac

development. Our findings support the hypothesis that myoglobin expression could reflect specific maturational and functional requirements of the fetal conduction system, possibly contributing to its metabolic stability and electrophysiological specialization.

## Conclusion.

Myoglobin immunohistochemistry appears to be a reliable and practical tool for the identification and study of the fetal cardiac conduction system. Its routine application may improve diagnostic accuracy in SIUD by facilitating the detection of subtle conduction abnormalities potentially underlying arrhythmic mechanisms. In both pathological and forensic pathological settings, myoglobin represents a promising new tool that can simplify and standardize the identification of conduction tissue, reducing diagnostic uncertainty and supporting clearer explanations for families and legal authorities.

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## A case series of adolescent suicides in the Bologna area: what are we missing?

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**Introduction**. Suicide represents a significant issue during adolescence, defined by WHO as the period of life between 10 and 19 years of age, representing the phase between childhood and adulthood. According to the WHO, suicide is the fourth leading cause of death globally among individuals aged 15 to 19. It is further estimated that one in six adolescents has a diagnosable mental disorder, highlighting the complexity of the relationship between psychopathology and suicidal behavior [1]. In this context, it is noteworthy that autopsies are not consistently mandated due to social, cultural, or religious factors [2]. From a forensic perspective, international literature underlines how the integration of psychological autopsy (PA) – as a structured, retrospective reconstruction of the decedent's life, personality traits, and psychosocial context – represents a powerful tool for clarifying the manner of death in suspected suicides and for identifying modifiable risk factors for prevention [3].

**Materials and methods**. This study reports a series of suicide cases among adolescents referred to the Bologna Legal Medicine Institute between 2021 and 2025. The cases were analyzed through a review of scene investigation reports, autopsy reports, toxicological findings, and medical histories. For each case were recorded: the cause of death, the presence of known psychiatric disorders, pharmacological therapy, whether an autopsy and toxicological analysis were performed, and the presence of a suicide note. The data were also evaluated considering the potential contribution of PA procedures (structured or semi-structured interviews with relatives and peers, collection of collateral clinical and social information) which are increasingly recognized as a complementary investigative approach in juvenile suicide.

**Results**. Eight cases were identified (7 males, 1 female); the most common age group was 15 to 19 years old (7 out of 8). The suicidal methods included: hanging (5 cases), jumping from a height (2 cases), and drowning (1 case). A full autopsy was performed only in 4 subjects; in the remaining cases, only a scene investigation and external examination were conducted. Toxicological screenings were negative for psychotropic substances in all tested cases (4 cases), and one subject presented a low blood concentration of alcohol (0.2 g/L). Although no structured PA was performed in the presented cases, information about mental health were collected for all the subjects by investigators. Only one subject had a documented prior suicide attempt with psychiatric hospitalization and subsequent benzodiazepine prescription, while another showed a history of psychological consultations and self-harming behaviors. No formalized psychiatric diagnoses or ongoing pharmacological therapies were noted in the remaining cases. A suicide note was present in only 2 cases.

**Conclusions**. The male predominance (87.5%) reflects the well-known gender gap in suicide, not limited to adolescence, consistent with international data. Hanging was the prevalent method (62.5%), often presenting in atypical or incomplete forms, in line with European literature. In the examined series, psychopathology was known in 2 out of 8 cases; the absence of a diagnosis in the remaining subjects may reflect underdiagnosis, barriers to mental health service access, or a lack of clinically evident psychological symptoms. These findings are consistent with PA studies on youth suicides that describe a high prevalence of unrecognized or under-treated mental disorders, complex relational and scholastic stressors, and the

frequent absence of overt psychiatric care, suggesting that traditional medico-legal and clinical data alone may be insufficient to fully reconstruct the suicidal process in adolescents. In the two cases with documented vulnerability, previous self-harming behaviors or alcohol abuse were reported, both recognized in literature as risk predictors.

The absence of positive toxicological screening for substances of abuse suggests that, in this series, the act was not primarily mediated by acute intoxication but was instead embedded in more complex psychological or situational dynamics. However, from a medico-legal perspective, the lack of systematic autopsy and comprehensive toxicological testing may lead to misclassification of the manner of death and to missed identification of underlying risk factors such as substance use or iatrogenic effects.

In this scenario, PA emerges as an essential complementary tool. By combining structured interviews with relatives and peers, analysis of medical and psychiatric records, school performance, social media use, and possible suicide notes, PA can: support the differentiation between suicide, accident, and homicide in equivocal deaths; uncover latent psychopathology, relational conflicts, and stigma-related issues typical of adolescence; generate detailed information for targeted prevention programs and for judicial assessment.

In suspected juvenile suicides, a full forensic autopsy combined with systematic toxicological testing and, where feasible, a standardized psychological autopsy should therefore be strongly recommended to ensure an accurate determination of cause and manner of death, to document underlying vulnerability (including mental disorders, substance use, and treatment-related effects), and to provide robust evidence for both clinical suicide prevention strategies and medico-legal decision-making.

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## Pediatric deaths due to neglect and remote abusive trauma: a retrospective study from the Cook County Medical Examiner's Office in Chicago

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**Introduction**. Child abuse includes physical, psychological, and neglect-related forms, with neglect defined as the failure or refusal of a caregiver to provide adequate care, protection, nutrition, hygiene, medical access, or safe supervision. These omissions can lead to severe injury or death, particularly in vulnerable individuals such as infants. In the United States, 546,159 children were victims of abuse or neglect in 2023, representing a 19.3% decrease compared to 2019. However, the number of child deaths due to maltreatment increased by 9.6% during the same period, with a mortality rate of 2.73 per 100,000 children and an average of 5.39 deaths per day in 2023. Although most fatal outcomes occur shortly after abuse or neglect, some cases demonstrate a prolonged interval between injury and death, particularly following abusive head trauma or severe thoracoabdominal injuries, creating diagnostic and forensic challenges.

**Materials and Methods**. A retrospective analysis of pediatric deaths was performed using the LabLynx digital database of the Cook County Medical Examiner's Office in Chicago, Illinois. The study focused on two complementary patterns of fatal child maltreatment: deaths associated with neglect and delayed fatalities resulting from abusive injuries sustained early in life. Only cases in which the manner of death was certified as homicide following a complete forensic autopsy were included. For fatalities related to child neglect, pediatric deaths occurring between June 2016 and September 2025 were reviewed, excluding cases of self-neglect. Data collected included demographics, cause and manner of death, scene circumstances, comorbidities, investigative findings, and toxicology results. For delayed child abuse-related deaths, cases from 2015 through 2024 were examined.

**Results**. Eight cases met inclusion criteria for child neglect (6 males, 2 females). Victims included five infants aged 0 to 9 months, one toddler aged 19 months, and two children aged 4 and 10 years. Most were White (5), followed by African American (3). Leading causes of death were malnutrition, starvation, and or dehydration in four cases, and two infants died from drowning attributed to lack of supervision. Only one child had a documented prior episode of abuse. Seven delayed child abuse-related deaths (5 males, 2 females) were identified, all involving long-term sequelae of abusive head trauma sustained during infancy, between 2 weeks and 7 months of age. The interval between injury and death ranged from 1 to 15.5 years, with most deaths occurring more than 8 years after the initial trauma. Age at death ranged from 16 months to 16 years. Early findings commonly included intracranial and retinal hemorrhages and diffuse brain injury. Chronic sequelae were predominantly neurologic and included seizures, spastic quadriplegia, cerebral palsy, hydrocephalus, and developmental delay. Autopsy generally showed no significant gross brain abnormalities, except in one case with swelling and extensive encephalomalacia. Histologic examination revealed chronic ischemic brain injuries, including focal sclerosis, Wallerian degeneration, and hyalinized subdural neomembranes.

**Conclusion**. Complications of remote abusive injuries may complicate forensic interpretation and determination of manner of death. The aim of this study is to increase awareness among pathologists regarding accurate interpretation of the sequence of events in early and delayed pediatric deaths, in correlation with investigative findings.

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## From national guidelines to regional practice: operationalizing the SIDS protocol in Marche

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**Introduction**. Sudden Infant Death Syndrome (SIDS) remains one of the leading causes of post-neonatal mortality in developed countries. In Italy, Law n. 31/2006 and the subsequent Decree of October 7, 2014, established a mandatory multidisciplinary diagnostic pathway for sudden deaths in infants under one year of age and sudden intrauterine unexpected deaths (SIUD) after the 25th gestational week. Despite the regulatory framework, the practical application of these guidelines often faces organizational challenges. This work aims to illustrate the operationalization of the national protocol in the Marche Region (Resolution DGRM 1137/2015), highlighting the role of the Regional Reference Center established at the A.O.U. delle Marche.

**Materials and methods**. The Marche Region created a specific "Hub and Spoke" network connecting emergency services (118), territorial hospitals, primary care pediatricians, and the Reference Center. The operational protocol structurally differentiates the SIDS and SIUD pathways. For SIDS, the pathway is highly centralized and medico-legal: 1) Immediate activation of the forensic pathologist for a rigorous "Death Scene Investigation" using checklists adapted from CDC guidelines to document environmental risk factors and body position; 2) Mandatory transport of the body to the Reference Center for a complete autopsy, preferably performed within 36 hours; 3) Mandatory preliminary radiological assessment (total body RX or CT) to rule out abuse or skeletal malformations; 4) Collection of samples for ancillary investigations, including toxicology, microbiology/virology, and genetics. Conversely, for SIUD, the region adopted a decentralized, clinical-pathological approach. Fetal autopsies and the crucial macroscopic and microscopic placental examinations are performed at the local birth hospitals. A local "Audit" team (gynecologist, pathologist, medical direction) evaluates each case; only samples from unresolved cases are sent to the Ancona Hub for second-level genetic and molecular testing.

**Results**. The dual operational model adopted in Marche ensures the systematic application of the national protocols while preventing the organizational overload of the Regional Hub. For SIDS, the centralized multidisciplinary team (Forensic Medicine, Pathology, Radiology, Virology, and Medical Genetics) effectively differentiates between natural causes (e.g., undiagnosed congenital anomalies, metabolic disorders, infections), accidental causes (e.g., suffocation in unsafe sleep environments), and violent deaths. Preliminary reports are available within short timeframes, while the final integrated report (including genetic testing for channelopathies) is provided within 3-5 months. The designated reference center for submitting the collected data is not clearly identified

**Conclusion**. Operationalizing the national SIDS/SIUD protocol requires a highly structured regional network and a multidisciplinary approach. The experience of the Marche Region demonstrates that distinguishing the centralized, medico-legal approach for SIDS from the decentralized, clinical-audit approach for SIUD is crucial for practical feasibility. This model not only standardizes diagnostic procedures and fulfills legal obligations, but also provides essential answers and genetic counseling to grieving families, ultimately supporting future

prevention strategies. Addressing the lack of a clearly designated reference center for data submission will be essential to further strengthen the system.

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## Beyond the autopsy: risk factors for targeted prevention in pediatric traumatic mortality

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**Introduction**. Mortality due to traumatic events in minors represents a critical public health issue with profound medico-legal implications. While such events are numerically infrequent, their preventability necessitates a rigorous forensic approach. Beyond establishing the cause and manner of death, forensic pathology serves as a pivotal tool in elucidating the socio-demographic and environmental determinants of lethal injuries, providing the evidence-based foundation for targeted injury prevention strategies.

**Objectives**. This study sought to characterize the forensic epidemiology of traumatic deaths in individuals aged 1–18 years through a multicenter database. The primary objective was to identify age-specific risk profiles by analyzing the correlation between circumstantial data, toxicological findings, and post-mortem injury patterns. Specifically, this research aimed to differentiate injury patterns and risk factors between childhood (1-13 years) and adolescence (14-18 years) to inform evidence-based preventive protocols and to enhance diagnostic accuracy in forensic practice.

**Materials and methods**. A retrospective study was conducted on a cohort of 111 traumatic deaths (aged 1–18) subjected to judicial autopsy at the Institute of Legal Medicine, University of Pavia.

The study design followed a two-tiered analytical approach:

1. Macro-analysis: classification of the entire cohort by manner of death (accident, homicide, suicide).
2. Micro-analysis: focused investigation of accidental deaths (n=80), evaluating variables including circumstantial factors, type of injury, manner of death, cause of death, and toxicological analysis. Statistical significance was assessed using Chi-square tests ($\alpha$=0.05) to compare two age-stratified groups: 1–13 years and 14–18 years.

**Results**. Accidents were the predominant manner of death (72.1%), followed by homicides (20.7%) and suicides (7.2%), with a significant prevalence in males (61.6%). Distinctly, age-dependent patterns emerged ($p < 0.05$):

- Ages 1–13: prevalent mechanisms included asphyxia, specifically drowning (42.5%), occurring primarily in extra-urban settings during daylight hours. Toxicological assays were negative.
- Ages 14–18: high-energy trauma secondary to road traffic accidents (RTAs) predominated (65%), showing a marked nocturnal incidence. Notably, 20.6% of these cases tested positive for exogenous substances. Autopsy findings consistently revealed complex polytraumatic patterns with fractures involvement, reflecting the high-energy dynamics of the fatal events.

**Conclusion**. The findings confirm that pediatric traumatic death is not a monolithic entity but a dynamic phenomenon dictated by developmental stages.

The transition from the environmental risks of childhood to the behavioral and substance-

related risks of adolescence demands a specialized forensic interpretation.
This study underscores the role of the forensic autopsy as an essential diagnostic and epidemiological surveillance tool.
A standardized forensic approach is crucial to providing the Judicial Authority with objective data and to developing specific prevention programs, bridging the gap between the autopsy room and public health safety.

## Unassisted perinatal deaths: to be, or not to be, is that the question?

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**Introduction**. The World Health Organization (WHO) defines a perinatal death as 'a death occurring at 22 completed weeks of gestation and over, during childbirth and up to 7 completed days of life'. This comprehensive definition includes stillbirth and early neonatal death. When a perinatal death occurs without witnesses, distinguishing natural causes from criminal acts poses significant forensic challenges. Neonaticide, generally defined as the killing of a newborn within 24 hours of life, includes a broader spectrum of relevant offenses. In such context, perinatal deaths can result from the deliberate harm or from the mother's failure to provide necessary care, as well as induced stillbirths resulting from intentional acts or omissions occurring before birth. Moreover, the concealment or destruction of the remains of the fetus constitutes an independent offence. This retrospective study analyzes autopsy cases of perinatal deaths that occurred in the judicial district of Freiburg, Germany, focusing on autopsy findings, maternal data, and circumstances of death. The aim is to identify recurring pathological and contextual patterns, assess potential indicators of criminal involvement, and discuss key forensic challenges.

**Materials and methods**. All cases of perinatal death, according to WHO definition, in which the birth occurred unattended, were retrieved from the forensic archives of the Institute of Legal Medicine of Freiburg (Germany) in the time frame 2000-2025. Each case was classified into one of three categories: neonaticide, non-neonaticide and undetermined. Data were collected regarding maternal characteristics, circumstances of the death, and forensic autopsy findings. Descriptive analyses were performed on the extracted data for the total sample and the three categories.

**Results**. A total of fifteen cases fulfilled the inclusion criteria over a 25-year period. Among all cases, 6 were classified as neonaticides, 5 as non-neonaticides, and 4 as undetermined. In all cases, except one, the mother was identified, with age ranging between 16 and 41 years. In the majority of cases deliveries occurred in domestic environments. A request for medical assistance during or immediately after the delivery was documented in six cases, whereas in other eight cases the corpse was abandoned and concealed. The place of concealment encompasses mother's home, garbage container, rural area and sewer system. In both neonaticides and non-neonaticides, the sex of the infant was predominantly female. Full-term gestational age was identified in the majority of neonaticides. In contrast, pre-term gestational age was observed in most non-neonaticides. All neonaticides showed signs of vitality, while all non-neonaticides were stillbirths. During the forensic autopsy, the hydrostatic test, both lung and gastrointestinal, was performed in all cases except two due to transformative processes. In neonaticides, the most frequent cause of death was drowning, followed by asphyxia and lack of perinatal care. In non-neonaticides, the primary cause of death was placental insufficiency. However, not in all cases the placenta was available for examination. The umbilical cord was most commonly severed; intact cords were observed only in a small number of cases, and in some cases the cord status could not be determined. Histological

analyses were performed in 7 out of 15 cases. Toxicological and genetic analyses were each performed in 3 out of 15 cases, while radiological imaging was performed in only 2 out of 15 cases.

**Conclusion**. This study highlights the marked forensic complexity of unattended perinatal deaths, in which the differential diagnosis between natural events and criminal conduct cannot rely solely on the demonstration of live birth. A standardized multidisciplinary approach, integrating scene investigation, full autopsy, placental examination, and radiological, histological and toxicological analysis is essential to ensure accurate determination of cause and manner of death.

Only through rigorous and systematic investigation can misclassifications be avoided and appropriate conclusions be reached.

## Autopsy investigation in juvenile suicide: a retrospective study from Milan (2020–2025)

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**Introduction**. Suicide is the third leading cause of death among individuals aged 15-29 worldwide and a major public health concern [1]. Medico-legal investigation of deaths in children and adolescents remains limited, as autopsies are performed less systematically than in adults due to ethical, social, cultural and religious factors [2], creating gaps in forensic and epidemiological data. This six-year retrospective autopsy case series of suicides among minors at the Institute of Legal Medicine of Milan aimed to identify patterns in manner of death and toxicological findings and to evaluate their medico-legal implications in relation to clinical and social variables. The findings highlight the value of autopsies in revealing the multidimensional vulnerabilities underlying youth suicide, contributing to a comprehensive understanding of the phenomenon and informing evidence-based public health and prevention strategies.

**Matherials and methods**. This retrospective study analysed suicide mortality in individuals under 18 using autopsy data from the Institute of Legal Medicine of Milan (2020-2025), identifying cases classified as suicide in Milan and Monza. Collected variables included age, date of the autopsy, medical and psychiatric history, pharmacological treatment, prior suicidal ideation or attempts, substance use, and access to social or mental health services and medico-legal findings such as manner of death and toxicological results on autopsy samples.

**Results**. A total of 24 cases were identified (17 males, mean age 16 years; 7 females; mean age 17 years). Males died by suicide more frequently than females, reflecting the well known "gender paradox", in which females report higher rates of suicide attempts, but males have a higher suicide morality. Cases increased from 1 in 2020 to a peak of 7 in 2022, then decline to 2 in 2025. Previous suicide attempts and suicidal behaviours were documented in 6 individuals (25%) and 8 individuals (33.3%), respectively, highlighting the presence of potential warning signs that may be relevant for preventive strategies. Overall, 14 subjects (58.3%) had a documented mental or behavioural disorder: 8 (57.1%) had psychiatric disorders, 1 (7.2%) a substance use disorders, 2 (14.3%) both conditions, and 3 (21.4%) neurodevelopmental disorders (autism spectrum disorder or Down syndrome). These findings support the strong association between youth suicide and mental illness reported in the literature. Half of the cohort had received psychological support, mainly among those with psychiatric and/or substance use disorders (10/14, 71.4%). Previous studies show that contact with mental health services is more common among individuals who die by suicide than controls but remains less frequent in younger population than in adults [3]. Autopsy findings identified falls from height as the most frequent mechanism of death (10/14; 71.4%), followed by hanging (9/24; 37.5%) while other mechanisms (railway incidents, gunshot wounds, and plastic bag suffocation) were less common. In contrast, the literature reports hanging as the leading mechanism among adolescents, followed by firearms in males and pesticide poisoning in females. In some cases, toxicological data was useful in providing a more accurate assessment of the circumstances of death, by highlighting acute intoxications that underlined other mechanism of death (e.g. hanging) or the presence of therapeutic drugs outside the expected dosage ranges.

**Conclusion**. A comprehensive medico-legal investigation, integrated with clinical and behavioural histories, is crucial to establish cause of death and identify psychiatric, psychosocial, and toxicological risk factors, thereby enabling the characterisation of vulnerable youth and informing targeted prevention and public health strategies.

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## Medico-legal patterns in filicide-suicide cases: why do parents kill minors before attempting suicide?

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**Introduction**. Homicide-Suicide (H-S) represents a rare yet complex forensic phenomenon where a perpetrator intentionally kills one or more victims before attempting, often successfully, suicide [1]. Reconstructing the dynamics of dyadic death poses significant challenges to the forensic pathologist, which exacerbates when minors are involved as collateral victims of intrafamilial dysfunction [2], psychological distress or distorted emotional responses. Such cases elicit profound public emotional impact, particularly with offspring involvement [3] While H-S cases has been studied extensively, filicide-suicide events remain greatly underexplored.

To address this gap, we conducted a retrospective multicenter study analyzing autopsy data form Italian Forensic Institutes happened in the 2010-2025 timeframe. We reviewed 86 H-S cases nationwide, classifying them by motive as: crimes of passion (CP), mercy killings (MK), and psychiatric disease-driven (PD). Of these, 11 involved offspring. Complete files – including medico-legal reports, toxicology, histopathology, radiology, and investigative records – were examined.

This presentation will give an insight on motives in homicide-suicide events with specific attention to cases involving minors, providing implications for forensic analysis and prevention.

**Materials and methods**. Data were entered into an Excel spreadsheet for variable comparison. Analyzed parameters included: demographic data (victim/perpetrator sex, age, etc.), relationship type, homicide multiplicity (single vs. multiple), methods/weapons used, wound characteristics, cause of death, and suicide methods. Spatial and temporal dynamics (e.g., same-site homicide-suicide, time lag) were assessed. Motive-specific medico-legal patters were then compared.

**Results**. A total of 11 cases were analyzed: 7 CP, and 4 PD, no minors were involved in MK cases. Victims were almost equally male (5) or female (6); perpetrators were predominantly female in PD, almost balanced in CP.

In CP cases, victim death was mainly caused by massive blood loss (MBL) from sharp-force wounds to the head or thorax; overkilling and defense wounds occurred in 3 cases. Suicides were predominantly caused by MBL or asphyxia, mainly due to sharp object wounds; only one case did not result in the death of the offender. In two cases a different weapon was used to commit the suicide compared to the homicide. Regarding PD cases, the most frequent victim cause of death was severe brain injury (SBI), mainly due to precipitation or firearms shots;

wounds were primarily on the head and neck. Overkilling and defense wounds were identified in 1 case. Lastly, for suicides, there were 2 attempted cases; the main cause of death was SBI, due to precipitation.

**Conclusion**. Our analysis highlights distinct forensic patterns reflecting underlying motives and facilitating differentiation between CP and PD cases. In CP cases feature sharp-force overkilling and defense wounds indicate an impulsive outburst of anger, often extending beyond the partner to the children as a form of "revenge" or "psychological torment" inflicted on the surviving partner, amplifying intrafamilial tragedy. Conversely, in PD cases, SBI from precipitation suggest extreme psychological distress or a distorted altruistic perception, wherein the perpetrator views shared death as the sole means to "save" the minor from a perceived cruel world, simultaneously alleviating their own suffering by dying together. These pattern underscore H-S with minors as extreme manifestations of intrafamilial dysfunction and psychological distress. Crucially, integrating autopsy findings with behavioral and contextual data enables more precise dynamic reconstruction, distinguishing motives, timelines, and suicidal intent. This approach not only strengthens casual attribution in forensic settings but may contributes to targeted prevention strategies: early identification of risk signals through multidisciplinary protocols could mitigate these tragic events.

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## History of filicides: a retrospective analysis of cases in Parma over the last 50 years

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**Introduction**. The unexpected death of infants (0–1 year) or children (1–14 years) represents a dramatic event not only for the victims' families but also for the public health of the societies in which these young individuals lived.
On this basis, a retrospective study was conducted on deaths of individuals aged between 0 and 14 years that occurred between 1975 and 2025 and were referred to the Institute of Legal Medicine of Parma. The aim was to analyze non-natural causes of death in order to identify recurring items that may provide preventive indications aimed at preserving life and safety of the most vulnerable individuals.
**Materials and methods**. The autopsy database of the Institute of Legal Medicine of Parma was consulted, selecting the period between 1975 and 2025. A total of 11,962 post-mortem examinations were performed. From these, the examinations concerning deaths of individuals aged between 0 and 14 years were extracted. Cases still undergoing diagnostic investigation or lacking information were excluded. The items considered were age, sex, year of death, nationality, cause and manner of death, with specific reference to homicidal manner. These data were entered into Excel files and processed for descriptive statistics.
**Results**. The total number of post-mortem examinations performed on individuals aged between 0 and 14 years was 269. Thirteen cases were excluded. The final sample was 256 post-mortem examinations. Of these, 65 were performed on infants (25.4% of the total), 191 were performed on children (74.6%).
Within the infant category, 45 deaths were natural (69.23%), 7 were accidental (10.77%), 6 were homicides (9.23%), 5 were road traffic accidents (7.69%).
Within the children subgroup, 118 individuals died due to road traffic accidents (61.78%), 42 due to accidents (21.99%), 14 due to natural causes (7.33%), 9 due to homicide (4.71%), 3 due to suicide (1.57%).
Considering both categories together, out of the 15 total homicide cases, mothers were responsible for 11 of them (73.33%). Among the causes of death, asphyxia due to external compression of the airways was recorded in 6 cases (40%), acute post-hemorrhagic anemia in 3 cases (20%), drowning and gunshot injuries in 2 cases each (13.33%).
In the present study, attention was focused on the manner of death within the two age groups in order to highlight potential items that could contribute to the prevention of non-natural deaths.
In this regard, a statistical significance was found between natural deaths (in infants) and accidental deaths (in children). This finding is not surprising, as due to the limited relational and environmental interaction capacities of the 0–1 age group, natural deaths prevail compared to traumatic deaths, predominant in children subgroup.
The most interesting finding concerns the homicides. In the infant group there were 6 homicides out of 65 cases (9.23%), compared with 9 homicides out of 191 cases (4.71%) in the children category. However, after performing the chi-square test, this difference did not reach statistical significance, although it aligns well with literature data regarding infant homicides in relation to the development of postpartum depression. Indeed, when analyzing

the perpetrators of these homicides, they were almost all attributable to mothers (83.3%), whereas in the 1–14 age group the homicides committed by mothers were "only" 6 (66.67%). Nevertheless, from the analysis of the circumstantial data it emerges that in almost all cases in our study there were warning signs regarding the psychological instability of the mothers involved. Some had confirmed psychiatric diagnoses, while others had unrecognized conditions. This finding aligns well with the relevant scientific literature in the Italian context, which reports that 56% of mothers who commit filicide present a psychiatric disorder prior to the event [1].

Regarding the causes and means of death, our findings differ slightly from the scientific literature. In our study, asphyxia due to external compression of the airways was predominant (40%), with a percentage almost double, while there was a total absence of injuries caused by sharp weapons and only a single case of cranial trauma.

**Conclusion**. In conclusion, a clear predominance of natural deaths was observed in infants, in contrast to traumatic deaths due to road traffic accidents in children. Fifteen homicides were identified, of which 6 involved infants and 9 involved children. The vast majority were perpetrated by mothers with established or unrecognized psychiatric disorders. Greater preventive attention in this direction is therefore recommended for the future.

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## Autopsy in sudden unexpected death occurring during the first year of life (SUID and SIDS): institutional experience from the Polyclinic University Hospital of Palermo

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**Introduction**. Sudden unexpected deaths during the first year of life remain a major diagnostic and medico-legal challenge. The term sudden unexpected infant death (SUID) includes deaths in which a cause can be identified at autopsy as well as cases that remain unexplained after complete post-mortem investigation, traditionally classified as sudden infant death syndrome (SIDS) [1]. Because SIDS is essentially a diagnosis of exclusion, a thorough forensic autopsy with appropriate histological sampling and evaluation of clinical and circumstantial data is essential to distinguish unexplained deaths from those due to natural diseases [2]. Institutional autopsy series therefore provide valuable information on the epidemiological and pathological spectrum of sudden infant deaths [3]. Over several decades, the Polyclinic University Hospital of Palermo has investigated numerous sudden infant deaths through multidisciplinary collaboration between the Units of Legal Medicine, Anatomic Pathology and Autoptic Diagnostics. The present study analyzes this institutional series to characterize the causes of death and the subset of cases remaining unexplained after complete autopsy investigation.
**Materials and methods**. We retrospectively reviewed 153 forensic autopsies performed between 1990 and 2017 on infants under one year of age who died suddenly and unexpectedly. All autopsies followed standardized protocols and included a full external and internal examination, serial sectioning of the cardiac conduction system, brainstem study and extensive histology [2]. Cases were classified as "not SIDS" (cum materia) when a cause of death could be established, and as "SIDS" (sine materia) when no cause emerged [1]. Epidemiological, clinical and socio-environmental data were collected from investigative files and caregiver interviews.
**Results**. Of the 153 SUID cases, 114 (74.6%) were classified as non-SIDS and 39 (25.4%) as SIDS. Death occurred in the neonatal period (< 28 days) in 47 cases (30.7%) and between one and twelve months in 106 cases (69.3%). Among non-SIDS cases, the main causes of death were cardiovascular diseases (38.6%), followed by respiratory diseases (26.3%), central nervous system disorders (12.3%), endocrine diseases (12.3%), gastrointestinal pathologies

(6.2%) and pancreatic diseases (4.3%); rare conditions such as Kawasaki disease and vascular malformations were also observed. The 39 SIDS cases showed a typical demographic and clinical profile: most were male (71.7%), with 18% born preterm and 54% small for gestational age. Death occurred predominantly during sleep (95%), usually in the crib or parental bed. Nearly half of the infants had a recent respiratory infection and markers of socio-economic disadvantage were frequent. Histology revealed recurrent minimal lesions, particularly in the lungs, larynx and spleen, mainly consisting of asphyxial changes and signs of developmental immaturity. Brainstem examination frequently showed abnormalities of the arcuate nucleus and serotonergic system, while analysis of the atrioventricular junction revealed developmental anomalies of the cardiac conduction system, suggesting a possible autonomic or arrhythmic vulnerability **[3]**. No metabolic, channelopathic or toxicological abnormalities were detected.

**Conclusion**. This institutional experience confirms the importance of meticulous autopsy investigation in sudden infant deaths. In infants under one year of age, about three quarters of SUID cases were attributable to identifiable natural diseases, mainly cardiovascular and respiratory, whereas one quarter remained unexplained and were classified as SIDS. The SIDS cases showed recurrent minimal histological lesions and developmental anomalies, supporting the hypothesis that intrinsic vulnerability of autonomic and cardiorespiratory control may interact with external stressors [3]. These findings highlight the need for multidisciplinary investigation and standardized autopsy protocols to improve diagnostic accuracy and distinguish SIDS from other causes of SUID [2]. The present study represents the second of two planned works and focuses on the institutional case series derived from our autopsy activity.

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## Patterns and differences in pediatric homicides: a 25-year retrospective analysis from Germany and Italy

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**Introduction**. Pediatric homicide represents the most extreme manifestation of violence against individuals under the age of 18 and remains a leading cause of death among children worldwide. Children account for more than 15% of all homicide victims globally, with approximately 40,150 deaths each year. While incidence data are available for individual countries from a strictly statistical standpoint, comprehensive comparative analyses exploring the various characteristics of pediatric homicides remain scarce. The identification of differences between countries, and particularly the understanding of these variations, may help clarify the factors underlying them and inform the implementation of precise and context-specific preventive strategies. Unfortunately, in many settings homicide data remain incomplete, substantially limiting the evidence base required for the development of effective prevention strategies. In this context, the role of the forensic pathologist becomes crucial in the systematic collection and documentation of data that enable the identification of potential recurring patterns, as well as significant differences among cases. The present study aims to evaluate and compare the epidemiological and medico-legal characteristics of pediatric homicides cases from two forensic case series, covering a 25-year period (2000-2025): a German group (Institute of Forensic Medicine of Freiburg) and an Italian group (Institutes of Legal Medicine of Padova, Pavia, Bologna, Messina).

**Materials and methods**. Cases of pediatric homicide (under 18 years) occurring over a 25-year period (2000-2025) were retrospectively selected from registries and databases of the Institutes of Freiburg, Padova, Pavia, Bologna and Messina. The corresponding autopsy reports were reviewed and data regarding the victim (age, age group, sex, nationality, clinical history), the perpetrator (age, sex, type of relationship with the victim, nationality, occupation, civil status, previous violence), the circumstantial context (day, time and place of the homicide, concealment, death in hospital, peri-partum homicides, medical attendance/call for assistance, homicide-suicide, multiple or other homicides, motive) and the autopsy-based forensic findings (methods of homicide, cause of death) were analyzed. Descriptive and inferential statistical analyses with univariate approach were performed to compare characteristics between the German and the Italian cases within each age group. Specifically, univariate analysis was conducted by stratifying the victims by age into two specific groups (<1 year and ≥1 year) and considering the following variables: sex of the victim, relationship with the

perpetrator, perpetrator's nationality, day and place of the homicide, concealment of the body, homicide-suicide, multiple homicides, methods of homicide and motive.

**Results.** Overall, a total of 39 German cases and 40 Italian cases were collected. Age-group stratification of victims identified 17 neonates (21.5%; 11 German - 6 Italian), 20 infants (25.3%; 9 German -11 Italian), 23 children (29.1%; 12 German - 11 Italian) and 19 adolescent (24.1%; 7 German - 12 Italian). Among victims, 49.37% belonged to the German cases, including 25.32% aged <1 year and 24.05% aged ≥1 year, whereas 50.63% were from the Italian group, with 21.52% aged <1 year and 29.11% aged ≥1 year. The comparative analysis between German and Italian cases across the two defined age groups (<1 year and ≥1 year), revealed a statistically significant difference in the <1 year age group regarding the place of homicide: in Germany, no outdoor homicides were reported (p 0.0307, OR 12.994, 95% CI (1.228 - ∞)). Furthermore, two other statistically significant differences were observed in the ≥1 year age group. The first concerned perpetrator suicide, which was absent in the German cases (p 0.0107, OR 5.250, 95% CI (1.454 - 21.591)). The other was related to the method of homicide (p 0.0337), with asphyxia being more frequent in the Italian cases (OR 2.173, 95% CI (0.334 - 24.069)) and gunshot also more frequently observed in this group (OR 1.304, 95% CI (0.237 – 8.677)). No statistically significant differences were observed between Germany and Italy for the remaining variables.

**Conclusion**. Although these findings provide important insights for understanding the phenomenon of pediatric homicides, further research on cross-country differences are needed to elucidate the underlying factors and to guide the implementation of context-specific prevention strategies.

## Micro-CT for the differentiation between live birth and stillbirth

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**Introduction**. In forensic investigations, being able to distinguish among neonaticide, feticide and intrauterine fetal demise (IUFD), is of paramount importance, whether it is a matter of criminal justice, civil affairs or alleged medical malpractice.

Radiological methods may offer further objective criteria for lung aeration, since computed tomography (CT) enables the differentiation of tissues based on radiodensity.

Although conventional CT has demonstrated effectiveness in identifying lung gas patterns, its resolution is limited to voxel sizes of about 1 $mm^3$. In contrast, micro-CT offers submicron resolution and has recently gained attention in biomedical applications.

We propose a new method to distinguish, qualitatively and quantitatively, between aerated and nonaerated lungs using micro-CT.

**Materials and Methods**. We analyzed two groups of lung samples (derived from cases examined at the University Hospital "Città della Salute e della Scienza" of Turin). Group 1 consisted of aerated lungs from five neonates and five adults. Group 2 included ten fetuses with a gestational age between 24 and 41 weeks.

For the adult cases, we recorded the age at death and the documented cause of death. For the neonatal cases, we recorded the age at death, cause of death, gestational age at birth, whether artificial ventilation had been performed, and the presence or absence of malformations or structural abnormalities of the lungs. For each fetus, we recorded the gestational age, the cause of stillbirth, the time interval between the intrauterine demise and the autopsy, whether artificial ventilation had been attempted after delivery, and the presence or absence of pulmonary malformations or abnormalities.

Each sample measured approximately 2 cubic centimeters. The apical region was chosen for all the samples because it is typically the most aerated part of the lung, thus maximizing the potential to detect differences in gas distribution between the two groups. All lungs had been entirely fixed in formalin prior to the sampling procedure. Each sample was scanned using micro-CT (X-ray Microtomography and SkyScan1172 Bruker) without any staining techniques. The acquisition time was set to 2 h. Subsequently, we used specialized software (CTVox) for analysis.

In the first step of our analysis, we examined the samples' scans to determine whether the micro-CT could identify gas within the formalin-fixed lung samples. We calculated the radiodensity using CTVox.
The second step involved identifying a quantitative measure that could serve as an indicator of the amount of gas present in each sample. We used the software CTVox to calculate a value representing the percentage of gas volume (GV%) out of the entire volume of the sample, using the following formula: GV% = gas volume (GV) divided by the entire volume (EV) of the sample multiplied by 100; GV% = (GV/EV) × 100. We calculated the mean and standard deviation of GV% values for each group.
In the third step, we conducted a preliminary comparison between Group 1 and Group 2 using the previously mentioned quantitative data.
**Results**. The means and standard deviations of GV% values were respectively: 9.52 ± 6.77 for Group 1 and 0.58 ± 0.66 for Group 2. The GV% value is independent of the sample volume, which is essential for enabling direct comparisons between samples of different sizes.
Based on the mean and standard deviation values for Group 1 (mean = 9.52; SD = 6.77), none of the individual samples fell below the lower bound of the mean minus one standard deviation (i.e., 2.75). This suggests that the distribution remains entirely above this threshold, indicating an overall shift of the dataset toward higher values.
According to the mean and standard deviation values for Group 2 (mean = 0.58; SD = 0.66), none of the individual samples exceeded the upper bound defined by the mean plus one standard deviation (i.e., 1.24). Thus, the dataset was not only characterized by low central values but also tightly clustered within a narrow range. The five cases slightly above the mean were linked to postmortem factors such as artificial ventilation, delayed autopsy, or infection.
**Conclusion**. In conclusion, this analysis indicates that micro-CT scans successfully distinguish aerated lungs from nonaerated fetal lungs and is useful to calculate gas volume percentages, which can be used for comparison. These findings support the potential of micro-CT as a reliable tool for assessing pulmonary aeration in forensic contexts. Additionally, micro-CT can examine samples without requiring staining compounds, eliminating the need for complex processing of the samples. Furthermore, this technique can study formalin-fixed samples, allowing for later revisions.
Our sample size is still too small to establish a definitive cut-off value for scientific and forensic applications and future research is needed to better determine how micro-CT might differentiate between live births and stillbirths in forensic practice.

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## The hidden vessel: forensic autopsy techniques for the examination of the ductus venosus in fetal and perinatal deaths

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**Introduction**. The fetal hepatic venous system is a key element of liver examination during fetal and perinatal autopsies. The ductus venosus plays a central role in fetal circulation, allowing the direct passage of oxygenated blood from the umbilical vein to the inferior vena cava. After birth, this structure undergoes physiological obliteration, forming the ligamentum venosum.

Macroscopic identification of the ductus venosus during autopsy may be challenging, particularly when conventional evisceration techniques disrupt the anatomical relationships between hepatic vascular structures. Accurate exposure and dissection of the ductus venosus are also relevant in the medico-legal setting, as vascular alterations such as congenital anomalies or ductus venosus thrombosis may be associated with acute fetal distress and intrauterine death, representing possible causes or contributing factors to fetal death. Prenatal ductus venosus thrombosis is described as a rare but potentially fatal condition that requires autopsy techniques capable of reliably identifying this structure[1].

**Materials and methods**. Two techniques for examining the ductus venosus during fetal autopsy were evaluated.

Fresh examination technique

After opening the abdominal cavity using an inverted Y-shaped skin incision, the umbilical vein is clamped and gently tractioned to expose its intra-abdominal course toward the liver. After retraction of the musculocutaneous flaps and inspection of the diaphragmatic domes, the sternal plate and ribs are removed to expose the pleural cavities and mediastinum. After removal of the thymus and opening of the pericardial sac, the thoracic segment of the inferior vena cava is identified and exposed. The falciform ligament is then sectioned to allow mobilization of the liver.

Examination of the ductus venosus requires two incisions in the hepatic parenchyma: one perpendicular to the line of attachment of the falciform ligament and a second in the right lobe approximately 2 cm from the first, with the blade inclined about 30°. This produces a wedge-shaped section whose apex corresponds to the intrahepatic course of the ductus venosus. Starting from the umbilical vein, the vessel can be opened continuously through the ductus venosus up to its confluence with the inferior vena cava.

Technique following en bloc evisceration and fixation

Following en bloc evisceration and fixation, the integrity of the diaphragmatic domes is assessed, and the inferior vena cava is identified within the mediastinum. The pericardial sac is opened to expose the entry of the inferior and superior vena cava into the right atrium.

In the abdomen, the gastrocolic ligament is sectioned and the stomach reflected cranially, allowing access to the retroperitoneum and identification of the main venous branches draining into the portal vein. After sectioning the falciform ligament, the liver is mobilised to expose the hepatic hilum, and the inferior vena cava is opened.

Due to fixation-related tissue changes, the ductus venosus cannot be opened but only inspected through incisions. The technique therefore requires a deep incision in the right hepatic lobe approximately 2 cm from the line of the falciform ligament, with the blade inclined about 30°, so that the plane of section intersects the portal vein, allowing it to be traced along its entire course up to its opening into the inferior vena cava.

**Results**. Application of the described techniques allows direct exposure of the ductus venosus and its confluence with the inferior vena cava, enabling accurate identification of its intrahepatic course while preserving its anatomical relationships with the portal system and hepatic vascular structures. Longitudinal opening of the vascular structures permits macroscopic evaluation of the vascular lumen and wall, facilitating the detection of morphological anomalies or pathological alterations, including ductus venosus thrombosis, stenosis, or congenital anomalies.

**Conclusions**. The proposed method represents a reproducible and practical approach for identifying and examining the ductus venosus during fetal and perinatal autopsy. Preservation of the anatomical relationships between the umbilical vein, the portal system and the inferior vena cava allows a more accurate morphological assessment of the fetal hepatic venous system compared with traditional dissection techniques. In the medico-legal context, systematic examination of the ductus venosus may be particularly relevant in cases of fetal death, especially when sudden or otherwise unexplained, as vascular alterations such as ductus venosus thrombosis may represent a primary cause of death or a manifestation of an underlying hemodynamic disturbance. Careful evaluation of this structure may therefore contribute to the identification – or exclusion – of a vascular cause of fetal death.

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## The pathology of starvation: a systematic review of forensic evidence

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**Introduction**. Deaths due to starvation arise from a distinct pathological condition resulting from prolonged nutritional deprivation and ultimately leading to multi-organ failure [1]. Although starvation has well-recognized medico-legal relevance, particularly in cases of neglect and abuse, the forensic diagnosis remains complex. It often relies on the integration of circumstantial information, anthropometric data and autopsy findings [2]. Previous studies have described the pathological and morphological features of starvation-related deaths [3]. However, given the need to interpret and integrate pathological findings within the broader forensic context, the extent to which published cases align with the methodological frameworks proposed in forensic good practice warrants systematic examination. This study aims to analyze published forensic cases of starvation-related deaths systematically, focusing on the diagnostic approaches adopted, the consistency of pathological findings, the contextual elements supporting cause-of-death attribution and the epidemiological patterns emerging from the reported cases.

**Materials and methods**. A systematic review was conducted in accordance with the PRISMA 2020 guidelines. PubMed, Scopus and Google Scholar were searched for studies published between 2015 and 2025 reporting post-mortem evidence of starvation or starvation-related malnutrition. Eligible publications included case reports, case series, and cohort investigations describing autopsy findings and relevant ancillary analyses. Only studies reporting post-mortem findings were included, whereas investigations based solely on ante-mortem clinical data were excluded. Extracted data comprised demographic variables, socio-environmental context, anthropometric parameters, macroscopic and histopathological findings and complementary diagnostic techniques.

**Results**. Fifteen studies met the inclusion criteria, including 20 individual cases and two cohort analyses encompassing 1647 deaths. Most individual cases involved pediatric cases (75%), frequently associated with domestic neglect, whereas adult cases were mainly related to anorexia nervosa or hunger strikes. Across studies, the most consistent autopsy findings included extreme emaciation, depletion of subcutaneous and visceral adipose tissue and generalized organ atrophy, particularly involving the liver, heart, pancreas and thymus. Histological examinations frequently revealed hepatic steatosis, myocardial atrophy, thymic involution and gelatinous transformation of adipose tissue. The analysis also highlighted the use of minimally invasive diagnostic approaches, such as tissue sampling, particularly in settings with a high burden of malnutrition and limited diagnostic resources. In addition, forensic literature reports cases in which ancillary techniques, including stable isotope analysis and bone mineral density assessment, have been proposed as a supportive tool for the forensic diagnosis of starvation, particularly in bodies showing advanced post-mortem transformation.

**Conclusion**. This review highlights recurrent morphological patterns associated with fatal starvation and emphasizes the methodological heterogeneity in forensic reporting. The

findings suggest that pathognomonic signs or strict diagnostic criteria do not establish the forensic diagnosis of starvation, but rather that it emerges from the integrated assessment of pathological findings alongside social and contextual factors. In this regard, the review highlighted the presence of recurring socio-contextual patterns, particularly cases of pediatric neglect, which, although uncommon, may also occur in developed countries. The emerging methodological approaches described in the literature require further investigation and validation, especially considering the relevance of specific contexts, such as resource-limited settings with a higher prevalence of malnutrition and situations involving advanced decomposition, as may occur in cases of neglect. Systematizing the morphological and methodological indicators reported in the literature contributes to improve diagnostic consistency and strengthen the evidentiary framework for attributing death to starvation in forensic practice.

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## Fatal blunt abdominal trauma in a child abuse context: a forensic case of jejunal blow-out perforation

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**Introduction**. Child abuse represents a major medico-legal and social issue, and its diagnosis may be particularly challenging when children present with internal injuries, as external traumatic signs can be minimal, nonspecific, or even absent [1, 2]. In abused children, abdominal trauma is an important cause of morbidity and mortality; the most frequently involved structures include the small intestine, liver, pancreas, and mesentery, and severe internal injury may occur despite limited superficial findings [2, 3]. Autopsy studies further show that fatal blunt abdominal trauma may coexist with evidence of previous injury, highlighting the importance of careful gross and histological examination in suspected non-accidental trauma [1]. In this setting, post-mortem imaging, autopsy, histopathology, and ancillary investigations are essential not only to establish the cause of death, but also to reconstruct the traumatic mechanism and assess the compatibility of the lesions with the reported history. We report a fatal case of blunt abdominal trauma in a young child in a suspected abuse context.
**Materials and methods**. A 3-year-and-8-month-old child (height 101.5 cm, weight 16.5 kg) was admitted to the emergency department with multiple blunt injuries involving different body regions. The child was unresponsive and presented with a distended, rigid abdomen. Ultrasound revealed abdominal distension with meteorism and free intraperitoneal fluid, while laboratory tests showed severe acute anemia (Hb 2.5 g/dL). Death was declared shortly after arrival. According to the mother and her partner, the child had experienced profuse vomiting and abdominal pain since the morning, followed by cyanosis and loss of consciousness. Due to suspicion of non-accidental injury, a judicial autopsy was ordered.
**Results**. Post-mortem computed tomography showed a large amount of free intraperitoneal air consistent with hollow viscus perforation, hemorrhagic fluid in the perihepatic, perisplenic, and pelvic regions, and a partially impacted fracture of the proximal tibial shaft without evidence of previous skeletal injuries.
External examination revealed multiple ecchymoses and abrasions over the face, neck, trunk, back, and limbs, with lacerations of the left auricle. Autopsy demonstrated severe abdominal trauma with hemorrhagic infiltration of the mesentery, mesenteric lacerations, traumatic jejunal blow-out perforation, omental injury, and extensive hemopneumoperitoneum with peritonitis. Notably, external abdominal bruising was minimal compared with the severity of the underlying visceral injuries. A transverse tibial fracture with marked hemorrhagic infiltration was also observed. Histology showed partially organized hemorrhagic extravasations in the skin and cervical tissues. Toxicological analyses detected only paracetamol (central blood, brain, liver, and hair). Clinical history suggested a delayed request for medical assistance.

Death was attributed to mixed traumatic, hemorrhagic, and septic shock due to severe abdominal injuries caused by blunt trauma.

**Conclusion**. This case highlights that severe and potentially fatal visceral injuries may occur in abused children despite relatively limited or nonspecific external findings. In such circumstances, a multidisciplinary medico-legal approach integrating post-mortem imaging, autopsy, histopathology, and ancillary investigations is essential to establish the cause of death, reconstruct the traumatic mechanism, and assess the compatibility between the observed injuries and the reported history.

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## Forensic autopsy in pediatric mortality: epidemiological patterns, causes of death, and a multidisciplinary forensic approach in a retrospective series of 79 cases

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**Introduction**. Pediatric mortality represents a particularly sensitive field in forensic pathology, requiring accurate determination of the cause and manner of death to address medical, legal, and social implications. Autopsy remains the gold standard for clarifying uncertain clinical diagnoses, detecting unrecognized natural diseases, and identifying traumatic or violent deaths. The present study aims to describe the epidemiological patterns and causes of pediatric mortality identified through forensic autopsy and to highlight the role of a multidisciplinary forensic approach in determining the cause of death.
**Materials and methods**. A retrospective review was conducted on 79 autopsies performed on fetuses, neonates, infants, children, and adolescents at the Institute of Legal Medicine of the University of Palermo between 2002 and 2025. For each case, the following variables were analyzed: age, sex, year of autopsy, cause of death, comorbidities, histological examination, toxicological analysis, radiological investigations, and identification procedures. Cases were categorized into natural deaths, accidental deaths, suicides, homicides, and undetermined cases. Particular attention was paid to the contribution of autopsy and histopathology in establishing the definitive cause of death. Special emphasis was placed on the integrated interpretation of autopsy findings and ancillary investigations, highlighting the importance of a multidisciplinary forensic approach, particularly in cases requiring toxicological assessment.
**Results**. The analyzed cases covered a wide age range, from fetuses and neonates to adolescents, with a predominance of male subjects. A significant proportion of deaths occurred in the perinatal and early infancy period, frequently related to placental pathology, perinatal hypoxia, congenital malformations, or infectious conditions such as chorioamnionitis and neonatal sepsis. Among infants, several cases were attributed to Sudden Infant Death Syndrome (SIDS), sometimes associated with anatomical abnormalities of the brainstem respiratory centers, including agenesis or hypoplasia of the arcuate nucleus. In older children and adolescents, traumatic deaths represented a substantial proportion, including road traffic accidents, falls from height, drowning, and fire-related injuries. Cases of violent death were also documented, including homicide (firearms, sharp force injuries, strangulation) and suicide (hanging and poisoning). Several cases involved migrant victims recovered after drowning, requiring combined forensic, anthropological, and identification procedures. Rare natural causes were also observed, including disseminated fungal infection, cardiomyopathies, metabolic disorders, and severe infectious diseases. Histological examination was performed in most cases and proved crucial for diagnosing infectious, inflammatory, and congenital conditions, particularly in perinatal deaths and sudden unexplained deaths. Ancillary diagnoses, such as post-mortem imaging, provided valuable information to improve diagnostic confidence and conclusions about the cause of death. Toxicological analyses were selectively performed in cases with suspected exposure to toxic substances or drug ingestion.
**Conclusion**. This retrospective analysis highlights the essential role of forensic autopsy in pediatric deaths, particularly in distinguishing natural from violent causes and in identifying rare or unsuspected pathological conditions. Perinatal and infancy deaths were mainly

associated with hypoxic-ischemic mechanisms, placental pathology, and SIDS, while traumatic and violent causes predominated among older children and adolescents. Histopathology represented a key diagnostic tool, especially in cases of sudden or unexplained death. The findings emphasize the importance of a multidisciplinary forensic approach, integrating autopsy findings with histopathology, toxicology, radiology, and circumstantial investigation to ensure an accurate determination of the cause of death and to support both judicial and public health purposes.

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## The role of pediatric autopsy in the medico-legal evaluation of professional responsibility: a Wilms tumor case

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**Introduction**. Wilms tumor, also known as nephroblastoma, represents the most frequent primary renal malignancy in childhood, accounting for more than 90% of kidney tumors in patients under 20 years of age and approximately 5% of all pediatric cancers. Histological features play a pivotal role in prognostic stratification. In particular, 5–10% of cases display anaplastic histology, characterized by enlarged and hyperchromatic nuclei, atypical and polypoid mitotic figures, and marked cellular pleomorphism. These unfavorable variants are associated with significantly poorer survival outcomes compared with non-anaplastic forms [1, 2, 3].
**Materials and methods**. We report the case of a 4.5-year-old child affected by Wilms tumor. According to the medical history provided by the mother, the child had been experiencing persistent fever, reduced appetite, and recurrent abdominal pain for approximately eight months, until a sudden clinical deterioration occurred, marked by the appearance of a painful, tense, and distended abdomen. The patient was therefore referred to the Emergency Department. Abdominal ultrasonography revealed a large mass (approximately 100 mm in diameter) in the right hypochondrium, infiltrating the liver and compressing the right kidney, leading to immediate hospital admission. During hospitalization, a biopsy of the abdominal mass was performed and multiple cycles of chemotherapy were administered; surgical resection was not feasible due to the advanced extent of the disease. A medico-legal autopsy was carried out, including gross examination and post-mortem histopathological and immunohistochemical analyses, despite interpretative limitations related to advanced post-mortem changes and previous chemotherapy. A structured review of the available medical records was performed, including pediatric health booklet entries, Emergency Department documentation, imaging reports, and written communications between caregivers and healthcare professionals.
**Results**. Histological and immunohistochemical analysis of the biopsy demonstrated positivity for beta-catenin, EMA, vimentin, WT1, inhibin, and Wilms tumor markers, leading to the diagnosis of poorly differentiated nephroblastoma. The disease was staged as stage IV. The patient died slightly more than one month after admission following the development of a severe systemic septic condition. Autopsy examination revealed a massive neoplastic lesion with reduced consistency, lacunar architecture, and extensive necrotic-hemorrhagic areas, arising from the upper pole of the right kidney and infiltrating the right hepatic lobe, with complete destruction of the involved parenchyma. Metastatic dissemination was documented at the level of the diaphragm, gastric and intestinal serosae, and lungs. Post-mortem histopathological investigations confirmed the diagnosis of nephroblastoma. The cause of death was attributed to acute multi-organ failure in a child affected by poorly differentiated, metastatic stage IV Wilms tumor complicated by terminal septic shock.
**Conclusions**. The medico-legal evaluation of professional liability proved, in the present case, to be particularly complex, requiring a detailed reconstruction of the diagnostic and

therapeutic chronology from the onset of symptoms to death. The analysis highlighted multiple levels of potential professional responsibility, which differed according to the phase of the clinical course and the information available to each healthcare professional involved in the patient's care over time. A key element was the discrepancy between symptom history as reported by the caregiver and what could be objectively documented in contemporaneous medical records and written communications, which directly affected the medico-legal appraisal of each temporal phase. Although certain critical issues were identified within the diagnostic pathway, particularly with regard to delayed recognition of alarm signs and imaging findings, their medico-legal relevance varied significantly depending on the temporal window considered. In particular, earlier diagnosis in some phases could have led to an earlier identification of the neoplastic disease, albeit without modifying, in terms of a high probability approaching certainty, the risk of a fatal outcome, given the advanced stage and aggressive biological behavior of the tumor. Causality was explored using counterfactual reasoning, separating phases in which earlier work-up was plausible from those in which prognosis was unlikely to change. A rigorous, time-stratified medico-legal assessment was essential to correctly interpret the diagnostic pathway and the heterogeneous relevance of the identified critical issues.

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# Oral Presentations

## *Artificial Intelligence Topic*

## Artificial intelligence in forensic identification and age assessment: reliability, limits and professional responsibility

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**Introduction**. Artificial Intelligence (AI) is increasingly integrated into forensic sciences, particularly in age estimation and human identification. Deep learning models applied to radiological, odontological, skeletal, and molecular data have demonstrated high computational performance. However, forensic application requires not only statistical accuracy but also explainability, external validation, and judicial defensibility. This study critically evaluates the current maturity of AI in forensic identification, with particular attention to legally relevant thresholds and professional responsibility.
**Materials and Methods**. A structured narrative appraisal of the literature was conducted through PubMed, Scopus, EMBASE, and ScienceDirect up to February 2026. Thirty-three studies were selected addressing AI-based age estimation (DNA methylation, orthopantomography, pelvic radiographs, CT, MRI), dental and craniofacial identification, facial recognition in disaster contexts, and sex and ancestry estimation. Reported performance metrics, dataset characteristics, and validation strategies were analyzed.
**Results**. Radiological deep learning models demonstrated the lowest prediction errors in age estimation, frequently reporting mean absolute errors below two years and binary classification accuracies exceeding 90% at the 18-year threshold in selected datasets. In contrast, DNA methylation–based approaches generally showed broader prediction intervals, typically between three and five years despite neural network enhancement [1]. Multimodal models combining dental and skeletal indicators reduced dispersion to approximately ±1.5 years in subadult cohorts.
In personal identification, convolutional neural networks applied to dental panoramic radiographs achieved rank-1 accuracies around 85% and rank-5 accuracies above 95%, significantly reducing comparison workload [2]. Three-dimensional dental biometrics and AI-assisted craniofacial superimposition further demonstrated high discriminative performance. Sex and ancestry estimation models frequently exceeded 90% classification accuracy in adult datasets but remain sensitive to population representativeness.
Across domains, the highest diagnostic reliability was consistently observed when AI outputs were integrated with expert interpretation rather than used autonomously [3]. Limited external validation, dataset bias, and the opacity of certain deep learning architectures remain critical challenges.
**Conclusion**. AI significantly enhances efficiency and reproducibility in forensic identification and age assessment. Nevertheless, high predictive performance does not automatically translate into medico-legal reliability, particularly when binary legal thresholds such as the attainment of majority are involved.
AI should therefore be regarded as a decision-support instrument rather than an autonomous forensic authority. In the era of algorithmic tools, the responsibility for interpretation,

contextualization, and expert testimony remains with the forensic specialist. The legacy of the Magister lies not in resisting technological innovation, but in governing it through scientific rigor, transparency, and ethical accountability.

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## Digital quantification of fibrosis in the his bundle: a preliminary autopsy study using a commercial pattern recognition system

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**Introduction**. Histologic evaluation of the conduction system is still questionable in sudden cardiac death (SCD), where arrhythmic events often lack specific morphological findings [1]. However, anatomical disruption of the atrioventricular node and bundle of His is associated with SCD. If there is a history of complete heart block, histology usually shows changes in fibrosis and calcification. Thus, a quantitative assessment of fibrosis within the bundle of His may contribute to a better understanding of conduction system remodeling but standardized methods are lacking. Artificial intelligence (AI) could provide a quantitative solution to this diagnostic gap. Machine learning algorithms could allow for automated and objective tissue analysis, can minimize interobserver variability and enhance diagnostic precision. By using pattern recognition, AI enables a reliable measurement of structural changes extremely time-consuming to evaluate through standard visual microscopy.

**Materials and Methods**. The study aims to develop a digital image analysis pipeline for the objective quantification of fibrosis in the His bundle. The hearts were fixed and sampled according to AECP protocol, (2017), obtaining 64 histological samples from 16 autopsy cases then stained with hematoxylin-eosin (H&E). These slides were digitized at 40× magnification (Epredia P1000 scanner). The automated analysis was conducted utilizing a digital pathology platform equipped with a pattern-recognition module (QuantCenter 3.0, PatternQuant). The AI model was trained on a dataset of images, using information provided by expert pathologists to create a reliable reference baseline for the algorithm's learning process. The software processed colorimetric and structural data to automatically segment distinct histological compartments, classify tissue by defining two distinct patterns: fibrosis and cardiomyocytes, enabling calculation of their respective percentages within the total examined area. These digital measurements were compared with traditional microscopic evaluations, wherein a forensic pathologist visually examined slides to manually estimate the percentage of the fibrotic area.

**Results**. The study population comprised 16 consecutive autopsy cases (10 males, 6 females; age range 22-94 years, mean age 61 years) including 7 SCD and 9 non-cardiac death. Manually selected annotation areas ranged from 0.04 mm² to 30.7 mm². Software-selected areas ranged from 0.04 mm² to 27.59 mm², with a mean of 2.75 mm², corresponding to approximately 92% of the annotation area. Fibrosis evaluated by the expert pathologist ranged from 5% to 95% (mean 52.6%), the digital system ranged from 4.9% to 95.8% (mean 51.5%). Statistical analysis of these digital and manual assessments showed excellent agreement. A very strong

linear correlation was observed (Pearson's r = 0.98, p < 0.001), confirmed by Spearman's rank correlation (ρ = 0.98, p < 0.001). Lin's concordance correlation coefficient demonstrated high overall agreement (0.978, p < 0.001). Bland–Altman analysis revealed a minimal bias of –1.0%, with 95% limits of agreement ranging from –12.1% to +10.1%.

**Conclusion**.These findings support reliability and reproducibility of digital image analysis for quantifying fibrosis in the His bundle, even in morphologically complex tissue regions. The low bias highlights the automated model performs similarly to a human expert, providing a minimally conservative estimate minimizing overdiagnosis risk. This performance confirms AI can reliably handle high throughput demands of modern pathological analysis [2,3]. This pilot study is a starting point in a broader research project evaluating the impact of fibrosis in the conduction system. This study aimed only to assess the workability of using digital software to quantify fibrosis in the His bundle. Although no significant association with age or cause of death emerged in this preliminary series, digital analysis of histological features provides a standardized tool for future large-scale investigations into the potential role of conduction system fibrosis in arrhythmic mechanisms and SCD. Applying AI into this pipeline can help reduce subjectivity in histological examinations. Combining algorithmic analysis with established medical expertise can improve diagnostic assessment of lethal arrhythmias and contribute to a more evidence-based approach in legal medicine.

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## A deep learning approach of forensic interest for automated segmentation and classification of skin wounds caused by blunt, sharp or gunshot trauma

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**Introduction**. Morphological characterization and classification of skin wounds represent crucial tasks in forensic medicine, given the frequent appearance overlap between abrasions and bruises or among lacerations, incised and gunshot injuries. The forensic wound examination and the diagnosis of the method of causation rely on careful observation, documentation, description of injuries, histological examination and comparison with the literature. However, this assessment remains largely experience-based and the need for a more accurate and objective wound examination has long been established [1].

Artificial intelligence (AI), particularly machine learning tools could help providing evidence-based analysis, reducing human subjectivity, speeding up the evaluation and improving the reliability of forensic evidence [2].

The overall aim of our study is to develop an AI-based approach for the automated identification and classification of forensic skin injuries and to explore its potential as a decision-support tool. To achieve this objective, the project was structured into three sequential phases: automated image semantic segmentation, followed by injury classification and development of an explainable AI model, that describes lesion features.

**Materials and methods**. A database of forensic skin injuries was created, comprising 183 wound photographs collected in the setting of forensic postmortem examinations. Wounds were classified, on the basis of the retrospective analysis of forensic reports, as abrasions (n = 35), bruises (n =25), mixed abrasions+bruises (n = 3), blunt lacerations (n = 42), incised wounds (n =61) and gunshot wounds (n =17). The semantic segmentation task was addressed using a previously published U-Net based neural network model (Deepskin), pre-trained on dermatological wound images [3]: according to an Active Semi-Supervised Learning (ASSL) training strategy, we performed a Transfer Learning (TL) procedure aiming to fine tune its parameters according to the current context. The automated identification of wound boundaries, body and background areas allowed the identification of the main region-of-interests (ROIs) for the next feature extraction procedure. Starting from the wound areas, indeed, a wide set of morphological and texture-based features were extracted for the characterization of lesions. A dimensionality reduction pipeline combined with Linear Discriminant Analysis classifier was developed for the stratification of lesion types.

**Results**. Our preliminary findings indicate that the employed ASSL + TL scheme guaranteed a faster convergence of the segmentation model, proving the effectiveness of domain-specific pre-trained weights. The supervised classification of lesion types based on the features extracted on the semantic segmentation ROIs highlighted a significant agreement with expert forensic pathologists. Using only morphological features, the most common skin wounds (blunt vs incised vs gunshot), bruises, and abrasions were correctly classified and recognized by the AI model.

**Conclusions**. This study provides an effective methodological framework for the accurate and reliable automated wound image segmentation, which could be applied to the forensic context. The developed AI-based pipeline proved the ability to capture relevant morphological patterns of different wound types, allowing reliable, rapid, and objective recognition and differentiation. The results support the continuation of dataset expansion and the progression to subsequent phases, aiming to quantitatively compare AI effectiveness with experienced forensic pathologists, highlighting its potential value as a supportive tool in forensic injury assessment.

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## AI in post-mortem cranial CT analysis of gunshot injuries: a pilot study on multimodal LLM performance in gunshot wound investigation

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**Introduction.** The integration of artificial intelligence (AI) into forensic pathology and radiology is rapidly expanding, providing new tools for image interpretation and decision support in medico-legal investigations. Post-mortem computed tomography (PMCT) has become an essential adjunct to autopsy, particularly in the analysis of gunshot injuries, where morphological features are critical for differentiating entrance from exit wounds and thus for reconstructing the dynamics of firearm-related events. While previous forensic studies have explored AI performance in the analysis of macroscopic autopsy images for gunshot wound classification [1][2], the performance of multimodal AI systems in the interpretation of PMCT images of gunshot injuries has not yet been specifically evaluated. This pilot study aims to assess the performance of a multimodal large language model (LLM), ChatGPT Pro, in the analysis of PMCT images of cranial firearm-related injuries, with particular focus on its ability to identify and characterize bone defects and to perform differential diagnosis between entrance and exit wounds.

**Materials and methods.** Ten cases of individuals with cranial gunshot wounds resulting from a single gunshot to the head, examined by PMCT, were collected from the Universities of Padova, Pavia, Bologna, Modena and Reggio Emilia and Messina, yielding a total of 17 injuries (10 entrance and 7 exit wounds), with three cases presenting retained projectiles. One entrance and one exit wound involving the splanchnocranium were excluded from the analysis, resulting in a final sample of 15 injuries (9 entrance and 6 exit wounds) analyzed.

ChatGPT Pro (Instant version, OpenAI) was instructed using selected bibliographic sources in forensic pathology, forensic radiology, and anatomical atlases. Two standardized prompts were developed through iterative refinement, combining step-by-step interaction with the model and reference to best practices in prompt engineering.

Prompt 1 required the analysis of three PMCT images: two whole-skull multiplanar reconstructions (axial, coronal or sagittal planes) and one zoomed-in multiplanar image of the bone defect (in a selected plane). Prompt 2 required the analysis of two images: one zoomed-in image of the defect and one three-dimensional volume-rendered (3D-VR) reconstruction of the cranial vault containing the defect. All images were processed using Horos software.

Each prompt included eight structured items: image diagnostic quality (Q1), presence of bone defect (Q2), defect laterality (Q3), anatomical region (Q4), predominant beveling (Q5),

internal vs external diameter (Q6), cone orientation (Q7) and type of defect (entrance vs exit; Q8). All 15 cranial gunshot injuries were analyzed with both prompts. For each prompt, five independent runs were performed (new separate chat sessions with identical inputs), yielding 75 analyses per prompt (150 analyses overall). Responses were constrained to predefined numerical codes and recorded in an Excel spreadsheet.
The most frequent response was considered valid. For all items, an instability index (discordant runs/total runs) was calculated. Results were compared with PMCT evaluation by an experienced forensic radiologist, considered the gold standard.
**Results.** In all cases, the model consistently classified image quality (Q1) as diagnostic and correctly identified the presence of a bone defect (Q2) with both prompts. Regarding anatomical localization of the gunshot injury (Q4), the model demonstrated improved performance with Prompt 2 compared to Prompt 1, with correct identification of the anatomical region in all cases, suggesting that 3D reconstructions significantly enhance anatomical localization. Conversely, laterality (Q3) was incorrectly assessed in less than half of cases with both prompts, despite the analysis being constrained to image laterality markers in Prompt 1 and to 3D reconstructions in Prompt 2.
For morphological assessment and classification (Q5-Q8), the model correctly classified the defect type (entrance vs exit) in more than two-thirds of cases, indicating a good capability in differential diagnosis. However, intra-model variability was observed, as reflected by instability indices, particularly with Prompt 1. This system-dependent variability may be influenced by confounding factors intrinsically related to PMCT images, such as multiple bone defects, comminution, radial fractures, radiopaque fragments, and metal-induced streak artifacts. These features, more frequently encountered in whole-skull MPR images, may have interfered with the accurate identification of the target defect, potentially leading the model to analyze non-target lesions or misinterpret relevant morphological features.
**Conclusion**. This pilot study suggests that multimodal LLM-based AI may represent a promising tool for the preliminary assessment of PMCT images in forensic practice, potentially supporting non-expert users in the identification, localization, and morphological characterization of cranial gunshot injuries. However, the observed variability and limitations in image interpretation - partly related to the use of selected static PMCT images rather than full DICOM datasets - indicate that accurate assessment relies on dynamic and multiplanar navigation across the entire imaging volume, as routinely performed in forensic radiological practice. Therefore, such systems cannot currently replace expert forensic radiological evaluation. Future perspectives include comparative analyses with other AI systems to further assess performance and consistency, as well as the development of dedicated deep learning models (e.g., 2.5D/3D convolutional neural networks) capable of integrating volumetric imaging data, with the aim of improving reliability and diagnostic accuracy in PMCT-based assessment of cranial gunshot injuries.

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## Digital pathology in forensic science: a systematic review of the literature with a focus on machine learning applications

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**Introduction**. Digital pathology (DP) and whole-slide imaging (WSI) have become increasingly integrated into clinical pathology, enabling digital archiving, remote consultation and computational image analysis. In recent years, the integration of artificial intelligence (AI) and machine learning has further expanded the potential of digital pathology through automated detection and quantitative evaluation of histological patterns [1]. Despite these developments, the application of digital pathology and AI in forensic medicine remains limited. This study presents a systematic review of the literature on digital pathology in forensic science, with particular emphasis on emerging AI-driven analytical approaches and their potential into forensic histopathology workflows [2].

**Materials and methods**. A systematic review was conducted following PRISMA guidelines. A comprehensive search was performed across PubMed, Scopus and Web of Science using keywords related to digital pathology, whole-slide imaging and forensic medicine. After removal of duplicates and a two-step screening process, eligible studies involving postmortem or forensic applications of digital pathology were included. Extracted data included study design, tissue type, digital platforms used, and main forensic outcomes. In addition, the potential implementation of machine learning–assisted image analysis is discussed through practical workflows achievable with open-source platforms such as QuPath a digital pathology software designed for the visualization and analysis of whole-slide images that allows manual annotation of regions of interest, extraction of morphometric and staining-related features, and training of supervised machine learning classifiers.

**Results**. The literature search identified 361 records (most of which regard clinical pathology); a total of 21 studies published between 2009 and 2025 met our inclusion criteria and were therefore included in the final analysis. The selected studies were conducted in Europe, North America, and Asia and included mainly observational investigations along with methodological and pilot studies. Most of them (15) analyzed postmortem tissues aiming to improve diagnostic and research methodologies, particularly through quantitative digital analysis in fields such as forensic neuropathology and organ morphometry. The remaining 6 studies focused on direct forensic applications, including validation of digital histology workflows and the use of computational approaches for the detection or quantification of specific histological findings. Overall, digital pathology allows histological slides to be digitized, archived and analyzed computationally, enabling objective quantification of tissue features, improved reproducibility of measurements and easier data sharing between institutions. Digital histology platforms such as QuPath, which enables automated cell

detection, morphometric measurements and machine learning–based classification of histological structures, allow the implementation of supervised machine learning models trained on annotated datasets, providing quantitative and reproducible measurements that may support forensic interpretation [3].

**Conclusion**. Digital pathology represents a promising technological advancement for forensic histology, particularly when combined with AI-driven image analysis. Digitalization of histological slides enables long-term archiving, remote consultation, and standardized quantitative analysis of microscopic findings, reducing subjectivity in histological interpretation. In addition, artificial intelligence and machine learning algorithms can assist in the automated detection and classification of histological features, allowing large datasets of digital slides to be analyzed in a reproducible and scalable manner. Although further validation studies and standardized protocols are required before routine forensic implementation, the integration of digital pathology and AI has the potential to significantly enhance quantitative analysis, reproducibility, and data sharing in forensic investigations.

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## AI-assisted forensic analysis of hanging-related ligature marks: a pilot study using convolutional neural networks

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**Introduction**. Artificial intelligence (AI) has become an important tool in many medical specialties; however, its application in forensic science and forensic medicine is still in its early stages. In forensic pathology, the identification and interpretation of ligature marks represent a crucial and often challenging issue. This evaluation frequently relies on the expertise and subjective judgment of forensic pathologists, and variations in interpretation or potential human error may affect the consistency and reliability of conclusions. Recent advances in AI, especially in deep learning, have demonstrated promising potential in medical and forensic image analysis. In this context, the aim of the present project is to explore the use and the feasibility of AI for the recognition, classification, and description of ligature marks associated with hanging, while also evaluating the strengths and limitations of this approach.
**Materials and methods**. This pilot study investigates the application of Convolutional Neural Network (CNN)-based deep learning to the automated classification of ligature marks in forensic pathology, with the specific aim of distinguishing hanging-related injuries from morphologically similar findings attributable to other mechanisms. A supervised binary classification model was trained on a curated dataset of standardized JPEG images sourced from forensic medicine atlases, comprising two classes: ligature marks consistent with hanging (positive) and marks attributable to alternative forensic aetiologies, such as strangulation or post-mortem artefacts, capable of simulating the macroscopic appearance of hanging (negative). Each training sample was paired with structured morphological annotations encoding discriminative features, employed to guide labelling and support feature extraction during model optimization. Following training and internal validation, the model was tested on an independent set of real-world case images provided by forensic pathology experts from the province of Messina (Italy), in order to assess its generalization capability and diagnostic accuracy in an operational forensic context.
**Results**. Following the training phase, the CNN model demonstrated substantial learning capacity in extracting and recognizing the key morphological features discriminating hanging-related ligature marks from those attributable to other forensic conditions. During the subsequent inference phase, in which the model was tested on real-world forensic case images, the system achieved encouraging classification performance, correctly distinguishing positive cases - compatible with hanging - from negative ones, suggesting a promising generalization capability beyond the training distribution. The study is currently in progress; the methodological framework has been established, with the definition of the criteria and imaging standardization necessary for the application and for the proper development and use of AI in forensic analysis.
**Conclusions**. The following ongoing study represents a pilot study on the use of AI in forensic pathology, particularly in the evaluation of death by hanging and, more broadly, asphyxiation deaths due to external compression of the airways. AI may represent a valuable support in the process of assessing and interpreting the ligature mark during the external examination of the

body. However, in order to complete the forensic diagnosis, other elements that cannot be assessed through image analysis alone are essential, such as certain physical characteristics of the ligature mark (e.g. consistency), additional data that can only be obtained during an autopsy, and circumstantial information that emerges during the inspection. Other limitations of the study include the limited dataset provided and the absence of a comprehensive 360° evaluation of the ligature mark injury. These limitations suggest that AI cannot replace the forensic expert but can rather represent a useful tool in supporting the evaluation of forensic cases to improve speed and accuracy. Future developments should aim at the creation of large serial datasets and standardized protocols shared among institutes of forensic medicine, in order to further improve the reliability and applicability of AI-based tools in forensic practice.

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## Will artificial intelligence replace the forensic pathologist? Inferential reasoning vs. correlational pattern-matching

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**Introduction**. Commercial generative artificial intelligence (AI) tools such as ChatGPT and Gemini now reach hundreds of millions of users and are increasingly employed for health-related information and clinical decision support. In forensic pathology, this raises the question of whether transformer-based large language models (LLMs), which predict the next token from statistical patterns in large text corpora, could ever replace the forensic pathologist. Inferential reasoning in medico-legal autopsy derives conclusions on cause, manner, and time since death from premises using deductive, inductive, and abductive logic, applied intuitively through hypothesis testing against autopsy data, whereas LLMs rely on correlational pattern-matching without explicit causal models or situational awareness.
**Materials and methods**. We frame forensic inferential reasoning as intuitive Bayesian updating: experience-based priors (e.g., "blunt force likely in high-energy motor vehicle collision") are updated with autopsy evidence (gross findings, histology, toxicology) according to the relative likelihood of competing hypotheses. Key applications include estimating time since death, determining cause of death (COD) and manner (e.g., homicide vs. natural). LLM functioning is outlined in accessible terms: self-attention mechanisms weigh relationships between words in the prompt, and stacked layers predict the next most likely token from co-occurrence statistics, without representing which event was the cause and which the effect. We then construct ten simulated autopsy scenarios covering a spectrum of common medico-legal questions on time since death, COD, and manner, including trauma, asphyxia, intoxication, and sudden natural deaths. Three representative cases are presented in detail as exemplars: (1) isolated blunt trauma, (2) stab wound with possible asphyxia signs, and (3) sudden cardiac death (SCD) with subtle fatty infiltration of the conduction system. In each simulation, an advanced LLM is prompted on time since death, COD, and manner, and its outputs are contrasted with structured human expert reasoning chains.
**Results**. In the simple trauma scenario (case 1) and in other low-ambiguity simulations, LLM responses largely match expert conclusions by reproducing frequent patterns encountered in its training data. Across the ten simulations, however, performance degrades when time since death estimation depends on less objectifiable data where human experts integrate multidisciplinary inputs to refine the interval. Case 2 highlights this: the combination of a stab wound and equivocal asphyxia signs elicits overconfident, sometimes hallucinated narratives (e.g., "homicide by stabbing with secondary strangulation"), while neglecting decomposition artifacts, scene context, or alternative asphyxia mechanisms. Case 3 (SCD) is critical: LLMs tend to assert "arrhythmic SCD due to fatty infiltration" on the basis of textual co-occurrences, although such histological changes are common incidental findings in young adults; human experts instead recognize low specificity, broaden the differential diagnosis, and require molecular or toxicological confirmation before causal attribution. Conversely, existing studies underline AI strengths in image-based forensic tasks. Pre-trained convolutional neural networks (CNNs) such as ResNet and GoogLeNet, fine-tuned on forensic datasets, can classify sharp-force injuries with overall accuracies around 88% and up to about 98% for stab

wounds on curated image sets, while automated segmentation and classification of seven common wound types achieve mean pixel accuracy of roughly 69% and mean intersection-over-union of about 49% on test images.

**Conclusion**. Current LLMs cannot replace forensic pathologists, because their pattern-based "reasoning", lacking explicit causal representation, contextual integration, and legal accountability, fails in rare, ambiguous, or high-stakes cases that demand human inference and normative judgment. Their main benefits arise in intrinsically correlative tasks: dedicated algorithms can accelerate digital pathology workflows, refine lesion and weapon differentiation from images, support 3D reconstructions from post-mortem imaging datasets (e.g., computed tomography volumetrics), and assist in standardized lesion measurements under expert oversight. Such tools require curated high-quality data, validation against autopsy gold standards, and continuous fine-tuning to handle case variability. Hybrid neuro-symbolic architectures may further enhance decision support, but human inferential expertise remains indispensable for medicolegal synthesis and certification.

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# Poster

## *Pediatric Topic*

## A mother's love: the manual strangulation of a child by his depressed mother – a case report

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**Introduction**. On an October morning in 2010, a depressed mother left home with her almost 3-year-old child. She may have intended only to calm him by driving around, or she may have had harmful intentions from the start, as she also took a kitchen knife. After hours of driving, she entered a wooded area and stopped in an unpaved clearing. There, as she later confessed, she manually strangled the child. She then tried to take her own life by driving the car down a slope, but her descent was blocked by the local vegetation. As a last resort, she tried self-inflicting some cutting injuries to her wrists and left chest, without success. Around 14:00 she called her husband, who was home with their 20 days old second child, telling him where she was and that she had killed their first-born. When he arrived at about 14:30, he recalled finding the child partly on the front passenger seat, head downwards as if he had slipped. After taking him in his arms, already noting the rigidity, he carried the body to the asphalted road and attempted resuscitation until medical help arrived, although his wife told him that it was useless, as she had killed the child roughly 3 hours earlier. The mother was later accompanied to the hospital, where she was diagnosed with "acute depression and self-injurious thoughts, multiple self-inflicted excoriated lesions".

**Materials and Methods**. The medico-legal investigator arrived at 18:00, describing livor mortis distributed posteriorly, facial cyanosis more pronounced on the lips and right side, pinkish nasal discharge, cyanotic stains on the neck, and rigor mortis of upper and lower limbs. The autopsy was performed the next day.

**Results**. During the autopsy, among the child's clothes, the bodysuit and the sweatshirt were stained with blood. There was also present a pillow with a white cover that showed no macroscopic organic traces. Rigor mortis was present at the mandible and limbs; livor mortis was fixed posteriorly, on the right half of the face, and on the right side of the neck. There was also present an early abdominal green discoloration. These signs allowed the examiner to collocate the death around the late morning of the preceding day.

During external examination, the face was smeared with blood from the nostrils, and white foam leaked from the right nostril upon mobilization. The face appeared faintly cyanotic; the right sclera and conjunctiva were slightly hyperemic. A horizontal solution of continuity was present on the inner lower lip. On the left side of the neck were observed small, faint, purple-colored, roughly oval-shaped ecchymoses that were close to each other. A superficial excoriation was noted on the left medial malleolus, and two small, purple-colored oval ecchymoses on the front of the right calf.

Upon removal of the external integuments, the scalp and pericranium showed an oval hemorrhagic infiltration in the left parieto-occipital region. The brain showed no trauma or pathology. Neck dissection identified multiple hemorrhagic areas in the paratracheal tissues, left pericarotid tissues, and neck muscles, more evident on the left. No trauma was found inside the carotid arteries. Petechiae were observed on the surface of the lungs, more on the right, and of the heart. The lungs showed emphysema and edema. Apart from poli-visceral congestion and purulent material in the right renal pelvis, no other traumatic lesions were present.

The scalp infiltration was attributed to a contusion produced in limine vitae, possibly from impact with the car interior during the descent down the slope, while the right calf ecchymoses matched a possible attempt to immobilize the child. Considering the hemorrhagic areas in the soft tissues of the neck corresponding to the cutaneous ecchymoses, the facial cyanosis, the pulmonary and cardiac petechiae, and the lung edema and emphysema, the examiner concluded that the primary mechanism of death was manual strangulation, adding the hypothesis of a suffocation attempt, with minor influence, based on the solution of continuity on the inside of the lower lip that was possibly produced by pressing the lips against the surface of the teeth.

Conclusions. Undiagnosed perinatal depression is a silent killer with devastating consequences for the entire family. After giving birth to a second child and feeling overwhelmed by the demands of the first child who showed suspected language delay and social difficulties, the mother began displaying alarming behaviors, dismissing medical evaluation of the boy, claiming the boy simply didn't want to speak or to learn, and that he engaged with others only when convenient. In addition, at the crime scene, she told her husband that everything was her fault, that she had failed, and that the child had "become a monster" because of her. Therefore, early recognition of maternal depression symptoms is essential to ensure better outcomes for both mother and child.

## Accidental mechanical asphyxia in unsafe sleep environments: a multidisciplinary forensic approach to SUDI diagnosis in two infant cases

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**Introduction**. Sudden unexpected death in infancy (SUDI) represents a major diagnostic challenge in forensic pathology. Among the recognized SUDI subtypes, accidental mechanical asphyxia occurring in unsafe sleep environments, including wedging and overlaying, is particularly difficult to ascertain, as post-mortem findings are frequently non-specific and no pathognomonic morphological markers exist [1]. A conclusive diagnosis therefore cannot rest on morphological findings alone but requires the systematic integration of autopsy data with ancillary investigations, including post-mortem CT scanning, histopathology, microbiology, toxicological and genetic analysis, alongside circumstantial information and scene reconstruction [2, 3]. The aim of this study is to present two autoptic cases of infant death attributable to wedging and overlaying respectively, emphasizing the critical role of a multidisciplinary medico-legal approach in reaching a conclusive diagnosis and excluding alternative causes of death.
**Materials and methods**. Two male infants, aged respectively five and two months, underwent complete forensic autopsy, including external examination, internal examination with histology, and post-mortem computed tomography (PMCT). Circumstantial data were obtained from investigative reports and scene reconstruction. In Case 1 (five-month-old), the infant was found prone in a crib, with the head entrapped between the mattress and the bars (wedging). In Case 2 (two-months-old), the infant was found in a parental bed during co-sleeping (overlaying). No relevant medical history was documented in either case.
**Results.** In Case 1 (wedging), external examination revealed a linear violaceous discoloration on the face, compatible with compression against the crib bars during entrapment, and signs compatible with resuscitation manoeuvres. Internal examination showed pulmonary congestion, subpleural petechiae and cerebral oedema with congestion. Conjunctival and thymic petechiae were absent. Histology confirmed diffuse visceral congestion without significant inflammatory infiltrates or pulmonary intra-alveolar haemorrhage; examination of the cardiac conduction system with Masson's trichrome stain was negative. PMCT was negative for traumatic injuries. Microbiological and toxicological analysis and genetic test were also negative.
In Case 2 (overlaying), external examination revealed facial discoloration compatible with external compression. Internal examination showed pulmonary congestion, cerebral oedema with congestion, and small haemorrhagic infiltrates with focal haemorrhagic suffusions within the diploic bone of the cranial vault. Conjunctival and thymic petechiae were absent. Histology confirmed diffuse congestion without significant inflammatory infiltrates or intra-alveolar haemorrhage; examination of the cardiac conduction system with Masson's trichrome stain was negative. PMCT was negative for traumatic injuries. Microbiological and toxicological analysis and genetic test were also negative.
**Conclusion**. In both cases, the cause of death was determined as accidental mechanical asphyxia in an unsafe sleep environment (wedging and overlaying respectively), within the spectrum of SUDI. These cases confirm that no pathognomonic anatomical or histological marker exists for mechanical asphyxia in infancy, and that a conclusive medico-legal diagnosis cannot rest on morphological findings alone. Forensic autopsy, complemented by ancillary

investigations, including post-mortem computed tomography, toxicological analysis, microbiological screening, histological examination of the cardiac conduction system, and genetic test, played a crucial role in systematically excluding alternative causes of death and other natural conditions. Although autopsy findings were largely non-specific, their integration with circumstantial data, scene reconstruction, and investigative information allowed an informed medico-legal interpretation of the fatal events. These cases highlight that in SUDI forensic evaluation, distinguishing accidental asphyxia from SIDS or inflicted injury requires a structured multidisciplinary approach, where each investigative component helps excluding competing hypotheses rather than identifying a single diagnosis.

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## Accidental pediatric deaths: forensic evaluation of airways obstruction and related fatal events

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**Introduction**. Fatal airways obstruction is a significant public health concern among pediatric population, with dramatic consequences for families. This phenomenon is often associated with organic foreign bodies (food) aspirated by children under 2-3 years old, both at home or school.
Many studies nowadays focused on the prevention and urgency treatment of these unfortunate events, following a rigorous pediatric methodology.
The forensic aim of this study is to investigate the main differences between causes of airways obstruction, to classify them and, as a second aim, to perform an accurate review of the literature.
**Materials and methods**. At first, we present an untypical case report of a 5-y-o child, dead in a huge underground oil tank, normally used by a local olive mill to collect wastewater from olive milling. The body was semi-submerged, floating on oily water. The emergency service has been activated immediately, but at their arrival, the child was already dead, with no possibility to be rescued.
An autopsy was requested by local authorities. The cause of death was accidental asphyxia secondary to airways clotting by muddy material (wastewater residues derived from olive milling).
This exam has been fundamental to investigate the real cause of death, crossing circumstantial data and forensic findings.
Data collected have been later integrated with the study of scientific literature of interest.
**Results**. The careful study, enriched with histological findings, confirmed lethal asphyxiating mechanism. Once the causal link has been confirmed, a scientific research has been performed using scientific database as far as PubMed is concerned.
37 studies have been considered following these criteria: pediatric asphyxia, airways obstruction, foreign body aspiration, olive oil. Only 9 of them had a medico-legal approach. Pediatric foreign body aspiration is the sixth most common cause of death between children [1, 2, 3]. All studies underline the difficulty to complete a diagnosis of asphyxia by forensic autopsies and try to focus on the activity of the child while it occurs the fatal event. Forensic literature presents a variety of classifications of asphyxia, without any shared medico-legal schema.
To our knowledge this is the first case report of aspirated olive milling as an airways foreign body, as a fatal cause of pediatric asphyxiation.
**Conclusion**. This study has been useful to give a scientific response to the authorities for this rare case of accidental pediatric death and to investigate all pediatric algorithm to prevent or treat children by emergency services. In forensic literature is an existing cause of death, even if it is rare in practice.
This case report permitted to us to produce a valid review of the current literature and to provide a reliable classification of these uncommon events.

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## Dark web drugs and dangerous games

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**Introduction**. Domestic accidents represent a significant cause of death and severe health impairment, frequently occurring in settings lacking direct medical supervision. In such contexts, a rigorous forensic assessment is required to exclude intentional, preterintentional, or negligent liability. We report the case of an 8-month-old infant who died following an acute event occurring at home, initially characterized by marked interpretative uncertainty due to a significant language barrier, poorly defined prior health status, the presence in the household of a "traditional" medicinal preparation not authorized by the European Union or the Italian Medicines Agency, and technically inadequate emergency management.
**Materials and methods**. A comprehensive medico-legal investigation was performed, including detailed scene examination and collection of circumstantial data, with management of the language barrier through cultural mediators. A full review of clinical documentation (pre-hospital emergency service, Emergency Department, Intensive Care Unit), resuscitation records, instrumental examinations (including total-body CT performed in vivo), and hospital toxicology results was conducted. The "traditional" drug found at the scene was analyzed, with translation and toxicological interpretation of label and leaflet information. A complete forensic autopsy was performed, including external and internal examination, systematic dissection of the upper airways and tracheo-bronchial tree, and detailed evaluation of lungs, heart, abdominal organs, and central nervous system. The brain was fixed and sampled according to standard neuropathological protocol. All circumstantial, clinical, instrumental, and autopsy findings were critically correlated for differential diagnosis among traumatic event, unrecognized natural disease, accidental airway obstruction/irritation, and intoxication.
**Results**. At 13:35, the child's father, who was at work, received a phone call reporting that the infant was severely ill. A relevant language barrier was present, as neither the mother nor the caregiver spoke italian. Emergency medical services were alerted at 14:08. Upon arrival, the child was in cardiocirculatory arrest. Ventilatory resuscitation with bag-valve mask was initiated, followed by orotracheal intubation (ETT size 3), performed without difficulty. An initial diagnosis of "cardiocirculatory arrest in suspected thoracic trauma" was formulated based on reported respiratory difficulties in preceding days (possible asthma), administration that morning of a second dose of an unspecified Chinese medication, the child's presence in the room with a 2.5-year-old sibling and the hypothesis that the latter may have stepped on the infant's chest. Neither child had ever been evaluated by a primary care pediatrician. Spontaneous cardiac activity resumed at 15:07. Due to persistent severe respiratory compromise, the tube was replaced with a larger ETT (4.5 mm). During direct laryngoscopy with illuminated blade, an intact, collapsed inflatable rubber balloon (approximately 4–4.5 cm) was identified and removed from below the vocal cords. Despite intensive support, hypoxic brain injury secondary to prolonged arrest proved irreversible. The infant died approximately 17 hours after the initial event due to diffuse cerebral edema with cerebellar tonsillar herniation and multiorgan failure, as documented at autopsy. Autopsy revealed subglottic, latero-posterior laryngeal decubital lesions with ischemic necrosis of the mucosal corium, morphologically consistent with prolonged contact with a foreign body. No skeletal


or visceral traumatic lesions were identified; total-body CT performed in vivo was negative for trauma. Analysis of the "traditional" drug revealed paracetamol, chlorpheniramine maleate, and "calculus bovis" (animal bilirubin), substances not recognized in Western pharmacopoeia; no evidence of lethal intoxication was found.

**Conclusion**. Death was attributed to hypoxic-ischemic encephalopathy with massive cerebral edema and cerebellar tonsillar herniation, secondary to prolonged cardiocirculatory arrest. The foreign body identified and removed from the laryngo-tracheal region must be considered the triggering etiological factor of the acute event, likely through vagal reflex activation leading to prolonged cardiac asystole and diffuse bronchospasm. Macroscopic, histological, and toxicological examinations did not identify additional pathological conditions independently capable of causing cardiocirculatory arrest and subsequent hypoxic-ischemic brain injury. Balloon ingestion is consistent with an accidental domestic dynamic in a context of inadequate supervision. The multidisciplinary approach enhanced differential discrimination among natural, traumatic, and accidental causes in a case of sudden infant death.

## Death of a newborn following a reported accidental fall: Abusive head trauma (AHT) or professional liability?

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**Introduction**. Head trauma is one of the most frequent reasons for pediatric emergency department admission and a major cause of morbidity and mortality in childhood. Initial assessment and management depend mainly on trauma severity and the patient's age. Accurate severity stratification is therefore essential, particularly in children presenting with apparently minor head trauma, and should be guided by age-appropriate clinical prediction rules, such as PECARN, in accordance with current Italian emergency department guidelines. In this setting, the exclusion of abusive head trauma (AHT) is crucial and requires a multidisciplinary evaluation based on clinical history, physical examination, imaging findings, and laboratory data. AHT, defined as injury to the skull or intracranial contents caused by blunt impact, violent shaking, or both, remains the most severe form of child abuse and the leading cause of traumatic brain injury in infants and toddlers, with high rates of mortality and morbidity.
**Case report**. A 4-month-old infant was brought to the emergency department after a reportedly accidental fall from the arms of his 12-year-old maternal aunt, from a height of less than one meter, without documented loss of consciousness. Initial pediatric evaluation was unremarkable, with no evident signs of recent trauma. Although cranial CT was recommended, the family declined further imaging and requested discharge against medical advice after receiving instructions for close observation. A few hours later, the infant returned to the emergency department because of feeding refusal, inconsolable crying, and vomiting; on re-evaluation, a right parietal hematoma was noted. Additional history then suggested a transient reduction in responsiveness immediately after the fall. Cranial CT revealed an epidural hematoma, and the child was urgently transferred for neurosurgical treatment. Despite surgical evacuation, the clinical condition rapidly deteriorated and the infant died in the early morning hours. In order to investigate the differential diagnosis between abusive head trauma and possible healthcare liability, a forensic autopsy and subsequent histological examination were performed, showing severe cerebral edema, minimal hemorrhagic findings also involving the dura mater, leukocytic infiltration, and a severe systemic pathological picture.
**Conclusion**. Within the clinical and diagnostic algorithm for pediatric head trauma, careful history taking and thorough clinical and instrumental investigations—including skeletal radiography, cranial CT/MRI, and ophthalmologic examination—are essential to identify warning signs suggestive of child abuse, such as subdural hematoma, intracranial injury, retinal hemorrhages, and rib or other fractures incompatible with the reported mechanism of trauma. In equivocal cases such as the present one, meticulous documentation of the anamnestic and clinical decision-making process is also crucial in order to assess and, where appropriate, exclude possible medical liability.

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## Delayed diagnosis of post-intubation tracheal stenosis after short-term intubation in a 7-year-old girl: a fatal case and medico-legal considerations

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**Introduction**. Acquired airway stenoses in children are relatively uncommon and are mainly related to post-intubation injury, with a reported incidence ranging from 0.9% to 3%, mostly after prolonged intubation. However, rare cases following short-term intubation have also been described. The diagnosis of post-intubation tracheal stenosis, especially in patients intubated for very short periods, may be challenging, particularly in the differential diagnosis with asthma and bronchospasm. In general, when a restrictive tracheal ring causing luminal narrowing is identified, treatment should be tailored to the individual patient and planned by a multidisciplinary team including endoscopists, surgeons, and otolaryngologists, through an elective and/or emergency surgical approach, once the tracheal pathology has been definitively established.
**Case report**. A 7-year-old girl was admitted to the Emergency Department because of headache and projectile vomiting. On arrival, she was comatose and showed anisocoria, greater on the right side than on the left. She underwent orotracheal intubation and a brain CT scan, which revealed a right temporoparietal intraparenchymal hematoma, an acute right extra-axial hemorrhagic collection, and a leftward midline shift. She therefore underwent emergency neurosurgery for rupture of a right temporal arteriovenous malformation; subsequent histological examination led to a diagnosis of cavernous hemangioma. After two days, the child was extubated and progressively weaned from intensive care, followed by a course of intensive neurorehabilitation. Spirometry performed before discharge showed moderate-to-severe restrictive ventilatory impairment in the absence of bronchospasm. She was discharged with right third cranial nerve palsy and mild right hemihyposthenia. Ten days later, following the onset of dyspnea, she was readmitted to the Emergency Department, where bronchostenosis was detected, with rapid progressive worsening leading to death. At autopsy, vertical sectioning of the trachea showed that, between the upper and middle thirds of the organ, the internal surface presented a thin concentric fibrous ring compared with the remaining mucosal surface, forming a raised membranous fold that caused marked sub-obstructive narrowing of the lumen. This lesion extended downward irregularly, involving approximately the space of two contiguous tracheal rings. Histological examination demonstrated obstructive fibrous and fibromuscular hyperplasia of the lamina propria, associated with nonspecific chronic inflammation.
**Conclusion**. In the present case, a severe narrowing of the tracheal lumen developed, leading to significant impairment of pulmonary oxygenation. This finding was attributable to contact between the distal portion of the endotracheal tube used during ventilatory support and the tracheal wall of the child during surgery and the subsequent weaning phase, resulting in excessive fibrous connective tissue proliferation. This appears to represent a rare complication, particularly considering the short duration between intubation and the onset of stenosis. The case raises relevant issues regarding criticism of clinical management and potential healthcare

liability, with implications in both criminal and civil law, as well as in relation to hospital organizational and management aspects.

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## Delayed fatal outcome of healthcare-associated Citrobacter koseri meningoencephalitis in a preterm infant: forensic autopsy and medico-legal assessment of a seven-month clinical evolution

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**Introduction**. Deaths occurring months after neonatal intensive care raise complex medico-legal challenges, particularly when judicial authorities require the forensic pathologist to evaluate a possible causal relationship between healthcare exposure and a delayed fatal outcome. Healthcare-associated infections caused by Citrobacter koseri represent rare but highly destructive neonatal conditions, typically associated with severe meningoencephalitis and long-term neurological sequelae. Fatal evolution several months after the initial infection is exceptional and poses relevant forensic interpretative issues. The present study describes a judicial autopsy performed in a preterm infant with delayed death secondary to severe post-infectious cerebral destruction following neonatal Citrobacter koseri infection acquired during hospitalization.

**Materials and methods**. A complete judicial autopsy was performed following a request by the Public Prosecutor in the death of a seven-month-old female infant born at 29 weeks of gestation and previously admitted to a neonatal intensive care unit. Clinical records documented a severe neonatal infection during hospitalization with progressive neurological deterioration. The forensic investigation included external and internal autopsy examination, extensive neuropathological evaluation, histological sampling of major organs, microbiological investigations, toxicological screening, and systematic review of medical documentation and clinical imaging studies. Particular attention was devoted to correlating autopsy findings with the documented clinical course and microbiological identification of the infectious agent.

**Results**. Clinical documentation revealed that the neonate initially presented stable neurological findings but developed a severe septic condition approximately ten days after birth, with progressive neurological impairment and epileptic crises. Molecular testing of cerebrospinal fluid later identified Citrobacter koseri as the etiological agent of a severe meningoencephalitic process. Neuroimaging documented diffuse cerebral destruction with encephalomalacia and progressive hydrocephalus.

Autopsy findings showed marked macrocrania with severe hydrocephalus and diastasis of cranial sutures. Upon opening the cranial cavity, approximately 2.2 liters of yellow-tinged intracranial fluid were released. The brain appeared markedly compressed and extensively liquefied, with profound cortical thinning, parenchymal malacia, and near-complete loss of recognizable cerebral structures. The cerebellum and brainstem also showed signs of compression and structural compromise. No congenital malformations, traumatic lesions, or signs of external violence were observed. Visceral organs were macroscopically unremarkable except for generalized congestion.

Histopathological and clinical correlation confirmed that the massive cerebral destruction and hydrocephalus represented chronic sequelae of severe neonatal meningoencephalitis caused by Citrobacter koseri, resulting in progressive neurological deterioration and eventual failure of vital brain functions approximately seven months after the initial infection.

**Conclusion**. This case represents a rare example of delayed death occurring several months after healthcare-associated neonatal infection. The forensic autopsy played a decisive role in clarifying the causal chain linking the initial nosocomial infection to the late fatal outcome.
From a medico-legal perspective, the case highlights the critical importance of integrating clinical documentation, microbiological evidence, neuroimaging findings, and post-mortem examination in the evaluation of deaths potentially related to healthcare. Severe neonatal infections may produce long-term neurological destruction leading to delayed mortality, and failure to recognize this causal continuum may lead to erroneous forensic interpretations.
The present case emphasizes the need for standardized forensic protocols in neonatal autopsy and careful multidisciplinary analysis when assessing potential healthcare liability in complex pediatric deaths.

## Delayed neonatal death after severe head trauma: forensic autopsy in the assessment of traumatic causality

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**Introduction**. Delayed deaths following severe neonatal trauma represent one of the most complex scenarios in forensic causation assessment. When prolonged survival follows major head injury and death occurs after intensive treatment and palliative care, the traumatic origin of death may become clinically and legally less evident. In such circumstances, rigorous medico-legal evaluation requires integration of circumstantial data, clinical evolution and post-mortem findings. We report a case of delayed neonatal death following severe cranioencephalic trauma sustained during a public transport incident, emphasizing the role of forensic autopsy in establishing traumatic causality.

**Materials and Methods**. A 23-day-old male neonate sustained severe cranioencephalic trauma during sudden braking of an urban bus. The infant, carried in a front baby carrier, was projected forward together with the mother, and the head struck a vertical metal support bar inside the vehicle.

Emergency admission revealed coma and extensive cranial injuries requiring urgent neurosurgical treatment, including decompressive craniectomy and ventricular drainage. Despite intensive care management, progressive neurological deterioration occurred, with recurrent intracranial hemorrhages and hydrocephalus. After approximately one month of treatment, therapeutic limitation was agreed with the family and the patient was transferred to a pediatric hospice for palliative care. Death occurred approximately six weeks after the traumatic event.

A complete judicial autopsy was performed, including detailed examination of the central nervous system and histological sampling. Clinical documentation, radiological findings and investigative records were reviewed for medico-legal correlation.

**Results**. Post-mortem examination demonstrated extensive traumatic cranioencephalic lesions, including residual cranial fractures, massive intraparenchymal hemorrhage predominantly involving the left cerebral hemisphere, diffuse subdural and subarachnoid hemorrhages and severe cerebral edema with advanced parenchymal colliquation. Brainstem structures showed marked edema consistent with terminal intracranial hypertension.

No congenital malformations, natural diseases or alternative causes of death were identified. Extra-cranial organs showed only nonspecific congestive changes related to prolonged hospitalization.

Correlation of circumstantial evidence, clinical progression and autopsy findings demonstrated a continuous pathological sequence linking the initial blunt head trauma to progressive intracranial hemorrhage, refractory intracranial hypertension and death.

**Conclusion**. This case illustrates the critical role of forensic autopsy in establishing causality in delayed traumatic deaths during early infancy. Prolonged survival, complex clinical management and end-of-life care may obscure the traumatic origin of death, making post-mortem investigation essential for medico-legal interpretation.

This case demonstrates that in neonatal traumatic deaths with prolonged survival, forensic autopsy remains the only objective method capable of definitively establishing the causal link between injury and death.

## Desire or obsession of motherhood? The tragedy of infanticide

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**Introduction**. The topic of infanticide among women with psychiatric disorders has attracted increasing attention in recent years, as demonstrated by the extensive literature addressing the issue. It continues to represent a significant area of interest for researchers and mental health professionals due to the complex therapeutic and medico-legal challenges it entails. Pregnancy and childbirth are pivotal experiences in women's life, but they represent phases of increased biological and psychological vulnerability. During this period, some women may develop obsessive–compulsive symptoms or a full obsessive–compulsive disorder (OCD), alone or in association with other psychiatric conditions. In cases of postpartum OCD, intrusive obsessions frequently take the form of distressing thoughts involving the possibility of intentionally or unintentionally harming the newborn. Such vulnerability may also limit the ability to formulate realistic or adaptive strategies for childcare when the mother perceives herself as unable to fulfill her parental role. Under these circumstances, some women may come to pursue extreme actions, including infanticide or infanticide–suicide, as the only conceivable resolution to their situation.
**Materials and methods**. We describe a case of infanticide–suicide involving a 3-month-old infant and her 41-year-old mother. The woman deliberately threw herself from the first floor of their residential building while holding her baby, from an estimated height of approximately 7,40 m. Despite the rapid intervention, the infant succumbed to the injuries sustained, whereas the mother survived. Accounts from witnesses indicated that, prior to the incident, the woman had displayed marked anxiety related to the wellbeing of her child, doubts about her maternal abilities, concerns about the possibility of unintentionally harming her child and unwilling to seek or accept support from family members or specialized medical personnel, partly due to fears concerning the involvement of social services that could have removed the infant from her custody after all the sacrifices and the several attempted pregnancies that she pursued abroad through assisted reproductive technologies (at first homologous and later heterologous).
**Results**. The case was addressed using a multidisciplinary approach, integrating autopsy findings, investigation scene analysis, and forensic psychiatric evaluation. A comprehensive autoptic examination was performed on the infant, who revealed evidence of severe traumatic brain injury, more specifically, full-thickness fractures of the cranial vault and diffuse subarachnoid haemorrhage were observed, the latter predominantly involved the regions of the cranial base and the cerebellar lobes. Further traumatic elements were visible across the vascularization of the basicranial regions, where the vessels appeared multifocally lacerated with surrounding perivascular haemorrhage. Some of these injuries were compatible with direct decelerative mechanical trauma affecting the brain parenchyma and were associated with lacerative and haemorrhagic foci, consistent with the reconstruction of the events. The integration of data derived from the scene investigation, together with interviews conducted with relatives, neighbours, and the specialized medical personnel involved in her care, allowed

the reconstruction of a highly complex clinical picture characterized by a significant psychiatric background. The woman had a previously established diagnosis of obsessive-compulsive disorder during adolescence. Following childbirth, she appeared to develop a markedly anxious attachment toward her newborn during the postpartum period, accompanied by heightened fears concerning the child's wellbeing. The analysis of the events, based on a forensic psychiatric evaluation conducted on the woman, highlighted the persistence of a personality disorder characterized by a significant paranoid component. Furthermore, in the evaluation of the woman's clinical management, potential elements of professional liability were identified regarding the physicians involved in her postpartum care. **Conclusion**. From a forensic perspective, the interpretation of traumatic lesions in infants involved in precipitation-related cases represents a significant diagnostic challenge in the reconstruction of the events, particularly when the child is held by the caregiver during the impact. In addition to the interpretation of injury patterns, which require the integration of autopsy findings with scene investigation, the collection of clinical-psychiatric information concerning the parental psychic profile is also necessary to determine the circumstances surrounding the events. Furthermore, according to the main features of the present case, the primary aim is not only to identify the major challenges in the forensic management of the minor but relies on the actual prevention of the tragedy of infanticide from the beginning.

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## Evaluating long-term outcomes in a child with AIDS and JC-virus infection

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**Introduction**. In the medico-legal field, evaluating a child's condition and prognosis is an inherently complex task, as it requires not only the assessment of the damage present and persistent at the time of examination and its potential worsening and/or improvement, but also an evaluation of how any underlying diseases may affect the achievement of normal developmental milestones. In some cases, a prognosis regarding the child's life expectancy is also required. This is particularly difficult to determine in the presence of chronic and progressive conditions. Here, we present the case of a 6-year-old girl who was diagnosed with Acquired Immunodeficiency Syndrome (AIDS) due to a previously unknown Human Immunodeficiency Virus (HIV) infection. The severity of her clinical condition, as well as the absence of any known prior medical assessments, led to the case being reported to the judicial authorities for suspected personal injury and/or abuse attributable to negligent or intentional parental behavior.

**Materials and methods**. Medical documentation relating to the child's hospitalizations was reviewed to reconstruct the patient's clinical history. Circumstantial evidence, including witness statements, social services reports, and various e-mails, was analyzed to better characterize the parents' conduct with regard to the child's health. With the assistance of a pediatrician, a medico-legal examination of the child was performed to assess her condition.

**Results**. Analysis of the available documentation revealed advanced AIDS, characterized by an extremely low CD4+ count (15/mm$^3$), consistent with an advanced HIV disease stage 3 immunological category (< 200/mm$^3$) [1], as well as multiple concomitant and subsequent infections requiring numerous broad-spectrum antibiotic therapies. At the time of first medical care, the child appeared severely emaciated, weighing 10 kg at 5 years and 9 months of age, with diffuse dental caries, otitis media with purulent discharge, and bilateral streptococcal pneumonia. She had not received mandatory vaccinations. The diagnosis of HIV infection (320,009 copies/mL) was established only one week after the first admission, owing to the parents' initial denial of any known medical conditions during the collection of the family medical history. When specifically questioned on this topic after the diagnosis, the mother reported that she had already been receiving highly active antiretroviral therapy (HAART) for known HIV seropositivity one year before pregnancy.

During her hospital stays, the child developed multiple opportunistic infections, including Pneumocystis jirovecii pneumonia, esophageal candidiasis, disseminated Mycobacterium avium infection, and progressive multifocal leukoencephalopathy due to JC virus, leading to severe deterioration in motor performance. At the medico-legal examination, the child appeared malnourished, with impaired motor coordination and gait difficulties secondary to muscle hypotrophy and weakness. Auxological parameters were below the 3rd percentile for age. Her skin was dry and pale, and her dentition was in poor condition, with diffuse caries. The child interacted minimally with the examiner, limiting herself to head and eye movements and remaining non-verbal for most of the examination.

**Conclusion**. Given the extremely low probability of vertical HIV transmission when the mother is properly treated [2], it is reasonable to assume that HAART was discontinued during the late stages of pregnancy, at delivery, and/or during breastfeeding, which was interrupted

only after 18 months. With regard to the child's permanent sequelae, despite current control of HIV viremia, there was evidence of progressive worsening of JC virus-related progressive multifocal leukoencephalopathy, with an estimated reduction in life expectancy on the order of decades [3].

The assessment of permanent sequelae in children is essential for identifying potential criminal offenses such as child abuse or personal injury resulting from negligent or intentional parental behavior. However, this case illustrates how, due to the ongoing psychological and physical development in pediatric age, it is often challenging to determine with a high degree of certainty the long-term outcomes of certain pathologies. A multidisciplinary evaluation, integrating medico-legal and pediatric expertise and supported by a thorough review of the relevant scientific literature, is therefore necessary.

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## Fatal disseminated blastomycosis in a migrant adolescent: a forensic autopsy case report

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**Introduction**. Blastomycosis is a systemic pyogranulomatous fungal infection caused by Blastomyces dermatitidis, a dimorphic organism usually acquired through inhalation of airborne conidia. Although primarily affecting the lungs, the infection may disseminate to multiple organs, particularly in immunocompromised individuals. Central nervous system involvement is rare but associated with a severe prognosis. Due to its nonspecific clinical presentation, blastomycosis is frequently misdiagnosed as bacterial pneumonia, tuberculosis, or malignancy. We report a forensic autopsy case of fatal disseminated blastomycosis in a migrant adolescent, highlighting diagnostic challenges and medico-legal considerations.
**Materials and methods**. A complete forensic autopsy was performed on a 15-year-old male migrant who died after hospitalization for a rapidly progressive systemic infection. The external examination documented multiple cutaneous dyschromic lesions and scars. Internal examination included detailed macroscopic evaluation of thoracic, abdominal, and cranial organs. Tissue samples from major organs were fixed in 10% buffered formalin and processed for histological examination. Sections were stained with hematoxylin–eosin and further investigated using PAS and Giemsa stains to detect fungal organisms. Clinical documentation and imaging findings obtained during hospitalization were also reviewed.
**Results**. Autopsy revealed diffuse pathological findings involving several organs.
The brain appeared swollen with multiple soft nodular lesions, while the heart showed fibrotic and gelatinous pericardial thickening with adherences and a rough epicardial surface. The lungs were edematous and hemorrhagic with abscess-like lesions. Hepatosplenomegaly and an abscess involving the left iliopsoas muscle were also observed.
Histological examination demonstrated widespread granulomatous and suppurative inflammation affecting brain, meninges, lungs, heart, liver, spleen, kidneys, and skin. Numerous fungal organisms morphologically consistent with Blastomyces dermatitidis were identified within granulomatous lesions using PAS and Giemsa staining.
The overall findings were diagnostic of disseminated blastomycosis with predominant pulmonary, cerebral, and cardiac involvement. Death was attributed to septic shock secondary to systemic fungal infection.
**Conclusion**. This case illustrates a rare fatal presentation of disseminated blastomycosis with extensive multiorgan involvement identified only through post-mortem investigation.
The nonspecific clinical features and rapid deterioration complicated ante-mortem diagnosis. In forensic pathology, autopsy and histological examination remain essential for identifying uncommon infectious diseases and clarifying causes of death.
This report also underscores the importance of considering systemic mycoses in vulnerable populations, including migrants exposed to prolonged stress, malnutrition, and limited access to healthcare.


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## Fatal gastric aspiration in a 23-month-old child: forensic assessment of congenital anomalies and medical errors

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**Introduction**. Asphyxia in the forensic context is a broad concept that can be defined as a situation where a body does not receive or utilize adequate amounts of oxygen. Widely different classifications are found, in the one proposed by Savageau et al., asphyxia is mainly divided into four groups: suffocation, strangulation, mechanical asphyxia, and drowning [1]. The primary cause of asphyxiation within the pediatric population varies significantly by age group. According to different studies, accidental suffocation by choking is a rare cause of death in toddlers and it may occur due to the presence of a foreign body, which represents the most common cause, or, more rarely, because of aspiration of endogenous fluids, such as reflux of the gastric content. This last condition is usually related to pre-existing medical conditions, which frequently remain undiagnosed [2, 3].
We present the case, referred to the Institute of Legal Medicine of Padua, of a 23-month-old male child who died from mechanical asphyxia due to the aspiration of gastric content. The death occurred following his last emergency room (E.R.) admission for fecaloma in a clinical history of 4-month chronic diarrhea.
**Materials and methods**. In this case, the circumstantial and clinical documentary examination was followed by a complete forensic autopsy, including external examination, dissection and sampling of both tissues and organs. The investigations were conducted following the European Guidelines for forensic investigations. After formalin fixation, histopathological examination of samples was performed using Hematoxylin and Eosin (H&E) and Periodic Acid–Schiff (PAS) staining. This study also involved a comprehensive review of the professional conduct, including the primary care physician who managed the child over the previous four months, the emergency department staff, and the resuscitation team.
**Results**. A comprehensive review of the clinical documentation revealed that the child had been suffering from chronic diarrhea and encopresis for four months. During his last E.R. admission, physical examination revealed a tender abdomen and the presence of a fecaloma. He was diagnosed with paradoxical diarrhea and subsequently treated with a phosphate-containing enema (PcE). Immediately before hospital discharge and in the next few hours, the toddler experienced recurrent episodes of emesis and diarrhea, followed by an altered state of consciousness and impairment of airway protective reflexes, resulting in respiratory tract obstruction from the aspirated gastric material.
Autopsy findings included partially digested food in the lower respiratory tract, acute pulmonary emphysema, circumferential pyloric hyperplasia, and sub-stenosis of an 8 cm segment of the small bowel. Furthermore, histopathological analysis confirmed the presence of both pyloric hypertrophy and intestinal sub-stenosis. Additionally, the lung samples revealed alveolar edema and rupture of the alveolar septa, with intra-alveolar and intra-bronchial gastric material. Integration of these data allows mechanical asphyxia due to aspiration of gastric contents to be identified as the cause of death.
The analysis of the clinical records revealed several errors. Specifically, the administration of PcEs is contraindicated in children up to 2 years old, and electrolyte monitoring is

recommended considering the possibility of ionic imbalance. Regrettably, despite both the clinical conditions and the risks connected to the use of this enema, the practitioners involved did not monitor fluid and electrolyte balance. Nevertheless, a definitive and certain causal relationship between these factors and the child's death cannot be established conclusively.

**Conclusions**. This case highlights the key role of the forensic pathologist in identifying underlying congenital anomalies, such as stenoses, which may predispose pediatric patients to aspiration. Unfortunately, as children in this age group often cannot describe their symptoms, physicians typically consider the most common abdominal issues, while more rare conditions are more difficult to identify.

However, herein it is not possible to state with certainty a causal link between the child's death and either the anatomical alterations or the use of the PcE.

In conclusion, reporting unusual findings in autoptic settings and adverse drug effects is essential to build up a scientific literature that provides clinicians with evidence to improve their practice and patients' safety.

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## Fatal hemolytic uremic syndrome in a child due to Shiga toxin–producing Escherichia coli: a clinical–autopsy correlation

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**Introduction**. Hemolytic–uremic syndrome (HUS) is a severe condition characterized by microangiopathic hemolytic anemia, thrombocytopenia, and acute renal failure, frequently associated with infection by Shiga toxin–producing Escherichia coli (STEC). While the course is usually self-limiting, rare cases progress to fulminant systemic complications such as septic shock, disseminated intravascular coagulation (DIC), and intestinal necrosis. We report the autopsy findings of a fatal pediatric case complicated by toxic megacolon and multiorgan hemorrhagic involvement.
**Materials and methods**. A 2.5-year-old girl initially presented with diarrhea and vomiting. After an initial Emergency Department visit with presumed infectious gastroenteritis, her condition worsened with bloody stools. Laboratory tests revealed leukocytosis, elevated hemolysis indices, hyponatremia, and renal impairment. She developed oliguria/anuria and altered consciousness and was transferred to a tertiary care center, where microbiological testing confirmed STEC infection. Despite intensive supportive care—including continuous hemodialysis, pharmacological therapy, and hemodynamic monitoring—the patient developed refractory septic shock, thrombocytopenia, and intestinal necrosis. An exploratory laparotomy with subtotal colectomy was performed; death occurred intraoperatively. Histology confirmed transmural hemorrhagic necrosis of the colon and cecum consistent with toxic megacolon. A judicial autopsy was conducted to determine the cause of death and evaluate potential medical liability.
**Results**. External examination showed a child with development appropriate for her age, multiple vascular access sites, and a midline abdominal incision; no traumatic injuries were observed. Internal examination revealed diffuse multiorgan hemorrhagic lesions. The brain was edematous with intraparenchymal hemorrhages. Serosanguineous effusions were present in thoracic and abdominal cavities. The heart, lungs, gastrointestinal tract, and other viscera exhibited petechiae and diffuse microhemorrhages. The surgical specimen showed colectomy from the cecum to the descending colon, with residual colon–rectum consistent with toxic megacolon and hemorrhagic mucosal necrosis of the small intestine. Overall findings were consistent with septic shock progressing to DIC in the context of STEC-associated HUS.
**Conclusions**. This case illustrates the rapid progression and severity of systemic complications of HUS in children. Integration of clinical, microbiological, surgical, and autopsy data is essential to understand pathophysiology, guide management, and support medico-legal evaluations. From a healthcare liability perspective, delayed transfer to a tertiary care facility was identified as a critical issue, although it could not be established that adherence to best clinical practice would have prevented death with near certainty.

## Fatal high fall of two brothers in the context of childhood risk-taking

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**Introduction**. We report an unwitnessed fatal fall from height involving two brothers, aged 11 and 14 years, born in Italy to Kenyan parents. The boys lived with their parents and three other siblings in public housing. Both fell from the eighth-floor balcony of their apartment building, corresponding to an estimated height of approximately 25 m. This report describes the medico-legal investigation of the manner of death, discussing the interpretative relevance of childhood behavioral factors in the forensic assessment of fatal falls from height.

**Materials and methods**. Emergency medical records and witness statements collected by police officers were reviewed. Scene investigation, post-mortem computed tomography (PMCT), autopsy, histological examination, and toxicological analyses were performed in both cases.

**Results**. The bodies were found close to each other in the courtyard, both in a supine position, at distances of approximately 3–4 m and 5–6 m from the base of the building. PMCT demonstrated closely comparable patterns of high-energy blunt force trauma in both victims, including pneumothorax, intrathoracic hemorrhage, fractures of the sternum, lumbosacral spine, pelvic ring, and bilateral lower limbs. Superficial large abrasions were identified on the face of the younger brother and on the neck of the older brother, without skull fractures in either case. Fingertip injuries were additionally documented in the younger child. Autopsy confirmed the radiological findings and showed an ascending aortic rupture in the older brother and a right atrial tear in the younger brother. The latter finding was of particular interest because it represented the only major visceral injury identified in that child despite the considerable height of the fall. The death was attributed to a hemorrhagic shock for both children.

**Conclusion**. The landing pattern, body position at recovery, bilateral open fractures of the tibiae and fibulae, and fingertip injuries consistent with an attempt to grasp fixed objects were all consistent with a high-energy accidental fall [1,2].

No injuries suggestive of restraint, assault, or a preceding physical struggle were identified. In fact, the morphology and extent of the abrasions suggest that they were sustained during the early phases of the fall, as supported by the absence of underlying fractures.

Police investigation also failed to identify evidence of domestic violence, disorder within the apartment, or witness reports of screams or noises consistent with interpersonal conflict. Suicide appeared less likely in the absence of documented psychiatric history, intoxication, or scene findings suggestive of deliberate self-harm.

On this basis, both deaths were classified as accidental. From a forensic perspective, this case is notable because the near-simultaneous fatal fall of two minors may initially raise suspicion of homicide or suicide. However, the interpretive framework must also include developmental and environmental factors known to influence injury risk in children and adolescents, including male sex, underestimation of danger, impulsive or emotionally driven behavior, and social vulnerability [3].

The case therefore highlights the need for a multidisciplinary approach integrating autopsy findings, radiologic evaluation, scene analysis, and circumstantial investigation, while also emphasizing the importance of involving other professionals, such as healthcare providers, social services, and educators, to improve understanding of the risks associated with these rare fatalities.

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## Fatal oleander poisoning in a 17-year-old girl: a forensic autopsy case report

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**Introduction**. Fatal intoxications caused by the ingestion of Nerium oleander have been reported in forensic literature, most frequently in the context of accidental ingestion or suicidal attempts. The plant contains potent cardiac glycosides, such as oleandrin, capable of inducing severe cardiotoxic effects and potentially fatal arrhythmias even after relatively small ingested amounts. From a forensic perspective, the diagnosis of oleander poisoning may be challenging, as autopsy findings are often non-specific and require correlation with toxicological analyses. We report a forensic case involving the death of a 17-year-old female found unresponsive in her bedroom at home. The victim had a documented psychiatric history, including mixed personality disorder with autistic spectrum traits and previous suicide attempts, one of which involved the ingestion of oleander leaves.
**Materials and Methods**. A complete medico-legal investigation was carried out, including death scene examination, autopsy, histopathological analysis and comprehensive toxicological investigations. During the death scene inspection, several objects were recovered near the corpse, including a basin and multiple containers (a glass and plastic bowls). A glass container held a yellow-green semi-liquid preparation suspected to contain plant-derived substances. These materials were collected and submitted for laboratory analysis. A full autopsy was performed according to standard forensic protocols, with sampling of major organs for histopathological examination. Tissue samples from the heart, lungs, brain, liver and kidneys were fixed in formalin, processed and stained with hematoxylin–eosin for microscopic evaluation. Toxicological analyses were performed on central and femoral blood samples using liquid chromatography coupled with tandem mass spectrometry (LC–MS/MS) for the detection and quantification of xenobiotics, including cardiac glycosides associated with Nerium oleander. The yellow-green solution recovered at the scene was also analyzed to determine the presence of oleander-derived compounds.
**Results**. External examination and autopsy excluded traumatic injuries. Moderate pulmonary congestion with whitish foamy material within the bronchi and larynx, diffuse cerebral edema with flattening of the cerebral gyri, and mild hepatic congestion were observed. Histopathological examination demonstrated severe pulmonary edema, ischemic neuronal changes involving the brain and cerebellar Purkinje cells, acute tubular necrosis in the kidneys, and hepatic sinusoidal congestion. Cardiac histology revealed focal areas of coagulative necrosis characterized by hyper-eosinophilic fragmented myocardial fibers, predominantly in the left ventricular myocardium, consistent with hyperacute ischemic injury. Contraction band necrosis and focal myocytolysis were also observed, indicating prolonged and excessive myocardial contractile activity. Toxicological analysis detected oleandrin in central and femoral blood at concentrations of 19 ng/mL and 8 ng/mL respectively, values consistent with lethal intoxication according to available literature. Oleandrin was also identified in the liquid preparation recovered at the scene. Additional toxicological findings included paracetamol within the therapeutic range and the presence of metoclopramide, an antiemetic drug.
**Conclusions**. The integrated evaluation of circumstantial evidence, autopsy findings, histopathological features and toxicological results allowed the identification of acute oleandrin intoxication as the cause of death, leading to myocardial ischemia and fatal

arrhythmia. From a forensic perspective, the diagnosis of fatal oleander poisoning may present several challenges. Autopsy findings such as acute myocardial ischemia, visceral congestion and pulmonary edema are non-specific and may overlap with other causes of sudden cardiac death. Furthermore, oleandrin is not routinely included in standard toxicological screening panels and requires targeted analytical methods, such as LC–MS/MS, performed in specialized laboratories. In such cases, the collection of detailed scene evidence and circumstantial data, together with targeted toxicological analyses and the integrated interpretation of autopsy findings, toxicological results and psychiatric history, becomes essential for establishing the cause and manner of death. This case underscores the importance of correlating histopathological evidence of myocardial damage with toxicological analysis to confirm the diagnosis in suspected cases of plant-based poisoning.

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## Fatal pediatric meningoencephalitis with atypical onset: the decisive role of forensic autopsy in cause-of-death determination

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**Introduction**. Pediatric meningoencephalitis may present with nonspecific symptoms and misleading neuroimaging findings, delaying recognition of central nervous system involvement. In sudden or unexpected pediatric deaths, incomplete microbiological evidence and complex clinicopathological correlations frequently shift diagnostic certainty to the post-mortem setting. We report a fatal case of probable infectious meningoencephalitis complicated by sepsis, highlighting the medico-legal value of autopsy and histopathology in reconstructing the pathogenetic cascade and excluding alternative causes of death.

**Materials and methods**. A 4-year-old boy was clinically evaluated with serial laboratory testing, brain CT and MRI, cerebrospinal fluid (CSF) analysis, and extensive microbiological investigations on blood, CSF, urine, and respiratory specimens. Empirical antiviral, antibiotic, and anti-inflammatory therapies were administered. After death, a complete forensic autopsy (post-mortem interval: 10 days) with comprehensive histopathological examination and immunohistochemistry (CD45, GFAP) was performed.

**Results**. The child initially presented with gastrointestinal symptoms and no early meningeal signs. On day 5, nystagmus prompted neuroimaging, which revealed a small left cerebellar lesion with inconclusive MRI features, initially raising a differential diagnosis including neoplasia. CSF showed marked pleocytosis, initially with lymphocytic predominance. Despite intensive care, the clinical course rapidly deteriorated to a fatal outcome. Autopsy documented severe systemic involvement, including diffuse alveolar damage with hemorrhagic features and findings consistent with disseminated intravascular coagulation, supporting septic physiology. Neuropathology demonstrated severe meningoencephalitis centered on the cerebellum and leptomeninges, with predominant lymphomonocytic infiltration (CD45-positive), neuronal damage (including Purkinje cell loss), and marked reactive gliosis (GFAP-positive). Extensive microbiological testing did not identify a definitive etiologic agent; transient HHV-6 DNA positivity in CSF was not confirmatory.

**Conclusion**. This case demonstrates how atypical clinical onset and inconclusive in vivo investigations may hinder etiological diagnosis in pediatric meningoencephalitis and generate significant medico-legal implications. In this setting, forensic autopsy, supported by histopathology and immunohistochemistry, was essential to define the cause of death, reconstruct the pathophysiological sequence leading to fatal systemic complications, and exclude alternative traumatic or non-natural causes. Even in the context of a prolonged post-mortem interval and negative microbiological findings, post-mortem examination provided objective clarification and diagnostic certainty. These findings reinforce the central role of pediatric forensic autopsy in sudden infectious deaths and highlight the need for integrating advanced molecular and analytical tools with artificial intelligence to further improve etiological attribution and medico-legal transparency.


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## Cerebral venous sinus thrombosis in children: lessons from a rare and fatal case

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**Introduction**. Cerebral venous sinus thrombosis (CVST) in children is a rare and complex condition, often associated with multifactorial etiology and a highly variable, non-specific clinical presentation. The incidence of pediatric CVST is estimated at approximately 0.67 cases per 100,000 children per year, with a higher frequency during the neonatal period[1]. Diagnosis can be particularly challenging because initial symptoms may mimic common childhood illnesses, such as respiratory infections or febrile syndromes, making early recognition difficult.

**Materials and methods**. We report the case of a three-year-old boy who, in early May 2023, initially presented with fever, cough, and vomiting, followed by general malaise and asthenia. Subsequently, he developed severe headache associated with recurrent vomiting and intermittent fever. On May 23, 2023, he was assessed in the Emergency Department for headache while under treatment for suspected bronchitis. After administration of paracetamol and mineral supplements and a brief clinical observation, he appeared to improve and was discharged home with a diagnosis of a presumed viral infection.

Over the following days, the child experienced vomiting with blood-streaked fluids and mucus, accompanied by progressive focal motor deficits, including right upper limb hemiparesis. These new symptoms prompted readmission to the Emergency Department on May 25, 2023. Emergency neuroimaging revealed cerebral venous sinus thrombosis complicated by intracranial hemorrhage and cerebral edema with significant mass effect. Despite prompt neurosurgical intervention, including mechanical thrombectomy and hemispheric decompressive craniectomy, the patient experienced progressive neurological deterioration, ultimately entering irreversible coma and subsequent brain death.

**Results**. Autopsy examination revealed subcutaneous and galea capitis hemorrhagic infiltration, evidence of craniotomy in the fronto-temporo-parietal region with bone flap, and a dural patch in the same area. The brain gyri were flattened, congested, and edematous, consistent with previous neurosurgical intervention. Parenchymal softening and hemorrhagic infarction were observed in the fronto-temporal region, with underlying subarachnoid hemorrhage.

Within the superior sagittal sinus, at its confluence with the straight sinus, a thrombus was identified - a large blood clot molded and adherent to the sinus wall, with color ranging from dark red to grayish and a tense-elastic consistency. The cause of death was attributed to cessation of brain functions in a patient who underwent resuscitation for coma resulting from acute CVST, associated intraparenchymal and subarachnoid hemorrhage, rostro-caudal degeneration from ischemic-irritative parenchymal injury, and intracranial hypertension.

**Conclusion**. This case suggests that a timely evaluation could have allowed earlier diagnosis of cerebral thrombosis, likely already present at the first hospital admission. However, given the unknown extent and severity of the thrombosis in its early stages and its impact on brain tissue, it cannot be stated that a different course of action by the clinicians during the May 23, 2023 Emergency Department visit would have prevented death with high scientific certainty. Even assuming an earlier diagnosis and intervention, the child may still have experienced neurological deterioration as observed.

The etiology of the thrombotic event remains uncertain. A subclinical infectious process is a possible cause, but a genetic thrombophilic condition cannot be excluded, as thrombophilia screening and a complete family history were unavailable, particularly because the child was born via embryo donation.
This case highlights the rarity and diagnostic challenges of pediatric CVST and emphasizes how its uncommon nature, coupled with symptom overlap with common pediatric illnesses, makes management particularly complex.

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## Forensic assessment of sudden death in pediatric age: the role of the scene investigation and autoptic examinations

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**Introduction.** Sudden death in pediatric age represents an event of high interpretative complexity in the forensic field, requiring a rigorous and multidisciplinary investigative pathway. In such cases, the determination of the time and cause of death cannot be based exclusively on testimonial statements or reported clinical data but must rely on the integration of the scene investigation, autopsy and laboratory investigations, particularly anatomo-histopathological analyses. The present work analyzes a case of sudden death in infancy, highlighting the central role of the scene investigation and post-mortem examinations in the correct identification of the cause of death.
**Materials and methods.** The case concerns the sudden death of a two-year-old child living with the mother in a community setting, who had presented for several days with influenza-like symptoms. The investigative process included the analysis of the documentation on file and the statements provided by witnesses and healthcare professionals, together with the performance of a medico-legal examination at the scene on the body. Subsequently, a forensic autopsy was performed. During the autopsy, samples of organs and biological fluids were collected for anatomo-histopathological and toxicological examinations.
**Results.** The medico-legal scene investigation made it possible to document significant post-mortem changes, such as already widespread rigor mortis and initial livor mortis, as well as thermometric values consistent with a non-recent post-mortem interval. These elements allowed a preliminary estimation of the time of death, which proved fundamental for the critical comparison with the timelines reported in testimonial and healthcare statements. The autoptic examination excluded the presence of traumatic lesions and oriented the interpretation toward a death due to natural causes, supported by negative toxicological findings. Macroscopic findings were largely non-specific, making recourse to histological analysis necessary. Anatomo-histopathological examination revealed, at the pulmonary level, peri-bronchial and peri-bronchiolar inflammatory infiltrates associated with vascular congestion and alveolar edema, consistent with a picture of acute bronchiolitis, plausibly of viral origin. This condition, in most cases, has a benign clinical course with spontaneous resolution; however, death may also occur in apparently healthy subjects. In the present case, the subject was older than 12 weeks and in apparent good health, without known anamnestic factors that could suggest a more severe course of bronchiolitis. The microscopic findings, however, showed the presence of chronic inflammatory changes of the gastrointestinal tract, the presence of tarry blood in the stomach associated with esophageal congestion, and a picture of microvesicular hepatic steatosis in the absence of obesity, suggesting the hypothesis of a complex systemic condition, potentially related to immune dysregulation. In this context, acute bronchiolitis would have developed on an immune substrate unable to effectively counteract the pathogenic agent, leading to a rapid clinical deterioration up to death.
**Conclusions.** The analyzed case demonstrates how the determination of the cause of death in the pediatric field requires a structured and multidisciplinary medico-legal approach. The medico-legal scene investigation proved fundamental for the correct estimation of the time of

death and for the critical evaluation of the statements provided, offering indispensable objective support in the temporal reconstruction of the event. Judicial autopsy represented an essential step, allowing the exclusion of traumatic, asphyxial, and toxic causes and, when associated with histopathological investigations, made it possible to identify the cause of death in an acute infectious respiratory pathology, underscoring the central role of microscopic investigations in forensic diagnosis. The systematic integration of scene investigation, autopsy, and laboratory analyses is therefore confirmed as indispensable to ensure scientific rigor and reliability of conclusions in the medico-legal field.

## Forensic autopsy in pediatric deaths: diagnostic and medico-legal implications of an unsuspected pulmonary vascular disease

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**Introduction**. Deaths occurring in pediatric patients represent a particularly delicate field in forensic pathology. In these cases, post-mortem examination is essential not only to establish the cause of death but also to clarify unexpected pathological conditions and potential issues related to healthcare liability. Sudden or rapidly evolving clinical deterioration in children may raise diagnostic uncertainties and medico-legal concerns. Herby, we present a pediatric case in which forensic autopsy was crucial in identifying an undiagnosed pulmonary vascular disease responsible for sudden death.
**Materials and methods**. We report the case of a 3-year-old male admitted to the emergency department after episodes characterized by transient loss of consciousness, perioral cyanosis and generalized hypertonia followed by hypotonia. Laboratory tests revealed thrombocytopenia and coagulation abnormalities, and the child was hospitalized for diagnostic evaluation. Shortly after admission, the patient developed sudden cardiorespiratory arrest unresponsive to advanced resuscitation maneuvers. A complete diagnostic autopsy was performed, including macroscopic examination and histological sampling of all major organs.
**Results**. External examination showed no significant traumatic findings. Autopsy revealed dilation and hypertrophy of the right ventricle. Histological analysis of the lungs demonstrated severe hypertensive plexiform arteriopathy involving small and medium pulmonary arteries, with marked intimal thickening and plexiform vascular lesions. Additional findings included right ventricular myocardial hypertrophy with focal ischemic changes and acute cerebral ischemic alterations. No evidence of pulmonary thromboembolism was detected.
The overall findings supported the diagnosis of severe pulmonary arterial hypertension with plexiform arteriopathy leading to acute right heart failure and terminal cardiocirculatory collapse.
**Conclusion**. This case highlights the fundamental role of forensic autopsy in pediatric deaths with unclear clinical evolution. Post-mortem investigation allowed identification of a severe and previously undiagnosed pulmonary vascular disease, explaining the sudden deterioration and excluding alternative causes of death. In similar scenarios, the forensic pathologist plays a central role in reconstructing the pathophysiological mechanism of death and providing essential information for both clinical interpretation and medico-legal evaluation.

## Hidden fragility: sudden death in Ehlers–Danlos Syndrome – a case report and literature review

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**Introduction**. Vascular Ehlers–Danlos Syndrome (vEDS) is a rare and severe autosomal dominant disorder caused by variants at the COL3A1 gene, coding for Collagen type III alpha-1 chain. Genetic modifications can variably express themselves through different symptoms' pattern and severity. This intrinsic heterogeneity makes early diagnosis particularly difficult, except when mutations are known in family history. Worryingly, in the most severe cases, vEDS complications concern arterial vessels and hollow organs through aneurismatic and digestive ruptures, often fatal. Complications are often the first sign of vEDS, confirmed only after genetic analysis.
Moreover, a punctual explanation of vEDS incomplete penetrance is still to be defined and similarly, microscopic and molecular conformity with genotype is to be agreed upon.
**Materials and methods**. We examined a case of a sudden death of a 16 years-old boy from Section of Legal Medicine of University Hospital of Ancona (Italy). While playing volleyball, after a minor trauma, he complained of persistent pain in his left shoulder. After clinical tests, a hematoma in the left axillary region and a left pneumothorax were found, deeming a CT as necessary. During this examination, the young boy had a cardiac arrest and despite resuscitation efforts, it was fatal. Among autoptic findings, we highlighted a massive left hemothorax, which was produced by a rupture of the left axillary artery and a peculiar vessel frailty. Microscopic observation detected thinned walls, reduced muscular components and markedly reduced elastic components, with an increase in collagen and occasional accumulations of ground substance. Genetic test broke down every doubt, making a diagnosis of vEDS and the identification of a new mutation.
Aiming to compare our own forensic experience with findings coming from the scientific community, we reviewed literature about vEDS molecular features and promising prognostic markers.
**Results**. Contrary to our autoptic findings, Foehr R et al shows that in a vessel's extracellular matrix there are activation of inflammatory-like patterns and deposition of abnormal collagen fibres. These outcomes prove that arterial walls are not thinner, but stiffer than normal, linking their appearance to that of a fibrotic tissue. [1,2] Moreover, Roeder M et al. evaluate walls stiffness through ultrasound and Sphigmocore, comparing it to blood pressure parameters. Therefore, wall stiffness is identified as a new diagnostic and prognostic marker. [3]
Although we cannot discuss whether an early diagnosis and a preventive treatment would have saved the16 years-old boy's life, we can certainly identify many of the most common complications acknowledged in literature, such as pneumothorax, vessel rupture, frailty and molecular composition. Some disagreements could be found in wall thickness, considered thinner in our observations. [1]
**Conclusion**. To this day, vEDS remains an obscure and life-threatening disease since clinical presentation and its molecular correspondence are difficult to evaluate. Nonetheless, these recent findings are promising, giving to interesting paths to follow on future research, though still open to discussion and further validation.


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## Hidden Threat: COC-associated massive fatal pulmonary embolism in a healthy adolescent

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**Introduction**. In an era of increasingly widespread adolescent contraception, the routine prescription of combined oral contraceptives (COCs) reveals an important biological paradox. While these agents represent essential tools for reproductive health, menstrual regulation, and hormonal management in the pediatric–adolescent population, they are also associated with measurable alterations of the hemostatic balance, promoting a prothrombotic state through increased coagulation factors and reduced fibrinolytic activity. Massive pulmonary embolism (PE), traditionally considered a condition affecting older or comorbid patients, may rarely occur in young, otherwise healthy individuals, leading to sudden and unexpected cardiovascular collapse in the absence of conventional risk factors such as prolonged immobilization, malignancy, or inherited thrombophilia.

**Case report**. A 16-year-old female was found in her bed unconscious by her mother at 6:30 a.m. Emergency medical services arrived to find the patient in asystole, hypothermic, with isocoric pupils. Advanced cardiopulmonary resuscitation was performed for approximately one hour, including endotracheal intubation and administration of 12 doses of adrenaline, without recovery of electrical activity; death was subsequently declared.

Her past medical history included euthyroid autoimmune thyroiditis and previous episodes of presyncope and vertigo. One month prior to death, she had started combined oral contraceptive therapy (drospirenone/ethinylestradiol). 10 days before death, she experienced a flu-like syndrome associated with rash and presented twice to the emergency department for vomiting and vertigo, and subsequently for postprandial epigastric pain and nausea. Electrocardiograms, laboratory tests, and abdominal ultrasound were unremarkable on both occasions, and she was discharged with symptomatic therapy. According to her parents, the following days were characterized by progressive asthenia, dizziness, epigastric pain, nausea, and dyspnea.

Autopsy revealed extensive thromboembolic material within the main pulmonary artery and bilateral pulmonary arteries, extending to lobar and peripheral branches, associated with multiple hemorrhagic pulmonary infarctions. The deep veins of the lower limbs, examined from the femoral segments, were patent. Histological examination confirmed pulmonary thromboembolism, demonstrating adherent thromboemboli within the right and left pulmonary arteries, with focal neovascularization and fibroblastic reaction near the intimal surface, extending into major branches, together with hemorrhagic pulmonary infarctions and diffuse pulmonary edema. Testing for Factor V Leiden and prothrombin G20210A mutations was negative, excluding common inherited thrombophilic disorders.

Similar thromboembolic events in adolescents receiving oral contraceptives have been described in the literature, often involving lower limb deep vein thrombosis and, in some cases, responsive to thrombolysis. Reported cases include teenagers on various COC formulations who developed severe pulmonary embolism after weeks to months of therapy, sometimes in association with inherited or acquired prothrombotic conditions [1] [2] [3]. In contrast, the present case is particularly noteworthy for the occurrence of a massive pulmonary embolism in the absence of detectable lower limb thrombosis, with histology revealing adherent

thromboemboli and focal neovascularization within the pulmonary arteries, and genetic testing showing no mutations in Factor V Leiden or prothrombin G20210A.

**Conclusion**. This case underscores the potential for fatal thromboembolic events in otherwise healthy adolescents on COCs and the critical role of thorough forensic evaluation in sudden unexpected death. In this patient, nonspecific prodromal symptoms - including vertigo, nausea, epigastric pain, asthenia, and dyspnea - preceded the fatal event despite two recent emergency department evaluations with unremarkable findings. The absence of detectable deep vein thrombosis at autopsy, together with histological evidence of adherent pulmonary thromboemboli and focal neovascularization, underscores the unique and severe nature of this event. Negative testing for Factor V Leiden and prothrombin mutations further supports the role of exogenous hormonal exposure as a likely precipitating factor.

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## Homicide of a minor perpetrated by another minor with multiple gunshots to the face and concealing of the body. Case report and literature review

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**Introduction**. According to the latest available data, in Italy in 2024 were reported 21 homicides involving minors. 17 minors were charged with homicide, all of them male, but only in four instances the victim belonged to the same age group. Moreover, in 2024 sharp weapons were the most frequently used means of homicide, accounting for 33.0% of cases, followed by firearms, which were used in 30.0% of homicides in the general population, while only in 1% of the cases involving minors. We report a rare case of homicide in which a 16 yo boy was killed by another minor using a firearm, with subsequent concealment of the body.
**Materials and methods**. A comprehensive medico-legal CSI was conducted. A PMCT examination was performed, followed by autopsy, toxicological analysis, and histopathological examination. Special attention was devoted to the assessment of the gunshot wounds, with detailed examination of wound morphology and reconstruction of the bullets' trajectories.
**Results**. The victim was found inside a blind well with a circular section measuring approximately 60cm in diameter and 3m in depth, originally sealed with a round concrete panel. The structure was located near a wooded area within the property of the perpetrator's house. The body was found in a prone position, with the upper portion in contact with the bottom of the well. Upon recovery, the body was in an advanced state of decomposition, with partial skeletonization attributable to cadaveric fauna activity. Marked tissue loss was observed involving the left hemiface; specifically, the left eyeball and the periorbital soft tissues were absent. PMCT showed two distinct ballistic trajectories. The first wound track originated at the medial aspect of the left orbital fossa extending to the right temporoparietal region, where a comminuted fracture with focal outward displacement of cortical bone fragments, consistent with an exit site, was found. A second wound track extended from the left mandibular angle to the cervical spine, where a 1 cm radiopaque metallic fragment was localized in the body of the 2$^{nd}$ cervical vertebra. According to the investigative records, 8 days prior, in the early hours the victim (16 yo) went to the perpetrator's (also 16 yo) house armed with a knife. The two had argued over trivial matters, small debts related to drugs they both used, as the victim tested positive for cannabis in a urine test performed PM. The perpetrator, using a firearm belonging to his father, discharged two shots directed at the victim's head at about 1.5m and subsequently concealed the body inside a well located within the property. The perpetrator left the weapon inside the house, then dragged the body of the victim by one arm to dispose of him in a blind-ended well located in the courtyard. The well was then concealed with leaves and soil. Afterwards, the perpetrator cleaned the blood off the courtyard and went to work. At lunchtime, he returned home, restored the firearm and disposed of the victim's personal belongings and motorcycle.
**Conclusion**. A rare case of murder was presented in which both the murderer and the victim were minors. Furthermore, a firearm was used as the means of killing, which is equally rare in murders involving minors in Italy compared to other countries. That could be attributed to the fact that firearm possession in Italy is strictly regulated in comparison to other countries. Despite the trivial matters of the dispute, regarding small debts and drugs, the region struck

by the gunshot wounds was the face, which is more frequently targeted in mafia executions. Lastly, the concealment of the body, which occurred in the home garden, can be classified as Grade 1 on Schneikert's severity scale. The Schneikert Severity Scale is a classification system used to assess the degree of PM body concealment which categorizes concealment behaviors into increasing levels of severity reflecting the extent of planning and efforts to hinder discovery and investigation. Since the body was simply deposited in a pre-existing well that was closed and concealed with leaves, it does not appear to support the hypothesis of premeditation [1].

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## Limits of postmortem interval and survival-time estimation in neonatal hypothermia deaths

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**Introduction**. Fatal hypothermia in neonates is generally established through circumstantial coherence, exclusion of alternative lethal pathology, and supportive autopsy and toxicological findings [1]; however, in forensic practice, the most problematic aspect is often not the attribution of cause of death but the temporal reconstruction of events. In these cases, the two central medico-legal questions are the post-mortem interval (PMI) and the possible duration of survival during cold exposure. Both estimates are intrinsically uncertain in neonates because heat exchange is rapid, body mass is very low, thermoregulatory responses are immature, and body temperature may already be markedly depressed before death, thereby limiting the reliability of post-mortem temperature-based calculations [2]. Moreover, survival-time estimation during cold exposure remains poorly evidence-based: even in adults, available predictions are largely model-based and context-sensitive rather than deterministic, making extrapolation to neonates particularly problematic [3].
**Materials and methods**. We present the case of an unidentified male neonate found dead on a winter morning in a small room inside a public facility in Southern Italy. The room was closed, and an air-conditioning unit was operating while delivering cold air. The body was lying supine on a white sheet placed on the floor, partially clothed, with one lower limb and foot partly exposed. Rectal temperature measured at the scene was 9.9 °C, while ambient temperature was 10.3 °C. The body and the underlying surfaces were moist, and the yellowish material found on the clothing was subsequently identified as urine. The infant weighed 2,800 g and measured 49.5 cm. A full forensic investigation was performed, including scene analysis, external examination, post-mortem CT, complete autopsy, histology, and toxicology.
**Results**. External examination showed depressed fontanelles, sunken ocular globes, mild rigor mortis, scant violaceous lividity in dependent areas, partially migratory and pressure-blanching, and no putrefactive changes. Post-mortem CT excluded skeletal injuries and major parenchymal abnormalities. Autopsy revealed no traumatic lesions of the skull, neck soft tissues, airway, or major vessels. The pleural cavities were free, there was no pericardial effusion, and the lungs were expanded and congested without gross focal pathology or airway obstruction. The heart was morphologically unremarkable, with persistence of fetal circulatory shunts. Abdominal organs were grossly unremarkable. The gastric mucosa showed a blackish lacquered appearance; after washing, multiple small diffuse dark lesions became evident. Histology demonstrated marked adrenal congestion with medullary hemorrhagic foci, pulmonary septal thickening and congestion, diffuse hepatic microvacuolization consistent with hypoxic stress, and gastric mucosal congestion with superficial microhemorrhages and focal coagulative necrosis consistent with Wischnewsky spots. Toxicological analysis detected acetone in the blood. In the absence of competing traumatic or natural causes of death and considering the circumstantial context and the convergent post-mortem findings, the cause of death was attributed to hypothermia. PMI could only be tentatively framed as broadly compatible with approximately 10–16 hours before the observation, while survival during cold exposure was cautiously hypothesized as most plausibly in the order of 4–6 hours and unlikely to have exceeded 10 hours.

**Conclusion**. This case confirms that, in neonatal hypothermia, the attribution of cause of death may be supported by coherent scene evidence, exclusion of alternative lethal conditions, and congruent autopsy, histological, and toxicological findings. By contrast, temporal reconstruction remains the weakest and most assumption-dependent component of forensic interpretation. In neonates, single rectal temperature values close to ambient conditions mainly indicate advanced equilibration rather than a reliable measure of elapsed time, and classical early post-mortem changes such as rigor, livor, and absent decomposition provide only limited additional resolution in cold environments. For this reason, both PMI and survival time should be expressed as broad, assumption-bounded probabilistic ranges rather than precise determinations.

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## Management of neurological complications and multi-organ failure in complex congenital heart disease: a forensic pathology perspective

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**Introduction**. Unbalanced atrioventricular canal defect (uAVC) represents an extremely rare congenital heart anomaly, with an incidence of fewer than 4 cases per 10,000 live births, posing a unique challenge for the cardiothoracic surgeon and the other physicians involved in the care process. Reported outcomes are generally poor and are largely influenced by the presence of associated malformations and by surgical complications, particularly neurological events.
Such complex congenital heart diseases are infrequently referred for autopsy; consequently, when confronted with these cases, the forensic pathologist must often revisit the relevant literature and reference texts to fully understand the underlying developmental abnormalities. Furthermore, a thorough understanding of the appropriate management of these highly complex and delicate clinical scenarios is essential for the forensic physician in order to provide a solid and well-substantiated medico-legal opinion regarding the conduct of healthcare professionals.
**Materials and Methods**. We hereby present a case of a newborn child with prenatal diagnosis of right-dominance uAVC, characterized by left ventricular and aortic arch hypoplasia, an ostium primum atrial septal defect, a ventricular septal defect, a common atrio-ventricular valve with leaflets that bridge over both ventricular inlets and a persistent left superior vena cava.
The patient was born at 38 weeks of gestational age, and the diagnosis of congenital heart disease was subsequently confirmed. On her 5$^{th}$ day of life, she underwent a hybrid palliative procedure (cardiac catheterization and open surgery), consisting of bilateral pulmonary artery banding combined with ductus arteriosus stenting. The procedure was technically challenging and complicated by hemodynamic instability, followed by the development of a left frontoparietal intracranial hemorrhage.
At approximately 2 months of age, the patient was discharged home in stable clinical conditions. At around 5 months of age, she developed new symptoms; imaging studies demonstrated ductal stent stenosis and aortic coarctation, resulting in markedly reduced distal aortic flow. A subsequent cardiac catheterization, performed for diagnostic purposes, was complicated by a second cerebral hemorrhage.
In the following days, the patient progressively developed multi-organ failure, significantly complicating clinical decision-making. Despite maximal supportive care, her clinical condition continued to deteriorate. As a last-resort measure, surgery was attempted; however, she died intraoperatively due to refractory ventricular fibrillation approximately at 6 months of age.
The Judicial Authority appointed a forensic pathologist to perform an autopsy. The purpose was to determine the time and cause of the infant's death and to evaluate whether any medical misconduct played a causal role.
**Results**. During the autopsy an old, organized subdural hemorrhage in the left fronto-parietal region of the brain was observed, along with a recent hemorrhage in the right thalamic area. The heart showed significant abnormalities, including generalized enlargement (130g), biventricular hypertrophy, and a thin septum with a 1 cm hole. Evidence of recent cardiac

surgery was present, including pericardial adhesions and an aortic stent with downstream narrowing. Lungs were enlarged and severely congested with multiple bilateral pulmonary consolidations. Tissue samples from multiple organs were preserved in formalin for further histological examination, if needed.
According to autopsy findings, the cause of death was acute heart failure resulting from ventricular fibrillation due to complex congenital heart disease, coagulopathy due to liver failure, multiple bilateral pulmonary consolidations, and sequelae of palliative hybrid intervention and diagnostic cardiac catheterization, both procedures complicated by cerebral hemorrhages of the left fronto-parietal lobe and the right thalamic region, respectively.
The primary cause of death, therefore, must be attributed to a series of pathological concurrent causes linked mainly to the severe impairment of ventilatory exchange and cardiac hemodynamics with severe acute biventricular failure.
The complications observed were considered foreseeable but not preventable, therefore the management provided by the healthcare team was reviewed and deemed appropriate. Both medical chart and autopsy findings supported these conclusions.
**Conclusion**. This case highlights the intrinsic fragility of patients with complex congenital heart disease, in whom adverse events such as cerebral hemorrhage may arise as a consequence of the underlying condition and life-saving interventions rather than specific procedural errors. It also underscores the challenge of balancing neurological risk against the need to correct a critical cardiac defect in the setting of multi-organ failure, where all therapeutic options carry an extremely high risk of mortality.

## Maternal double filicide by combined strangulation and smothering: a forensic case report

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**Introduction**. Homicides against minors can be conventionally classified by chronological age into four clusters that reflect specific characteristics: neonaticide (0–28 days of life); infanticide (1–11 months of age); pedicide, or young child homicides (1–11 years of age); and adolescent homicide (12–18 years of age). Young child homicides are most frequently perpetrated by family members, who may present with psychiatric disorders, with no significant sex differences. When a parent (biological, step-, or adoptive) kills his or her own child, the act is defined as filicide. The term encompasses a spectrum of behaviours ranging from unintentional to intentional acts of killing, from deaths related to maltreatment (such as abandonment, neglect, or exposure) to fatal assaults (such as suffocation, strangulation, or stabbing), and from covert to overt forms of child homicide. Maternal filicide is an uncommon but highly relevant medico-legal event, often associated with severe psychiatric disorders. We report a case of maternal double filicide in which post-mortem investigation demonstrated a combined mechanism of strangulation and smothering.
**Case report**. A man returning home from work was unable to enter the apartment due to a blocked door lock. After failing to contact his wife, emergency services were called. Upon entering the first-floor apartment, rescuers discovered the woman partially immersed in a liquid containing bleach, with the shower hose wrapped around her neck. One of the daughters was found lifeless on the corridor floor near the entrance of the bedroom, while the other child was lying on the floor inside the bedroom. Emergency medical services were dispatched and the woman was transported to hospital. Judicial inspection of the apartment was performed; both children underwent external examination and autopsy, supported by histopathological and toxicological analyses. The injuries observed were comparable in both victims and were consistent with violent mechanisms. Autopsy findings demonstrated violent mechanical asphyxia due to a combined mechanism of strangulation and smothering as the cause of death in both children. The woman was subsequently subjected to a forensic psychiatric evaluation and confessed to the homicides, describing the motive and dynamics of the events, which were consistent with the reconstruction established during the medico-legal investigation.
**Conclusion**. Relatively little is known about the factors and circumstances predisposing to maternal filicide, and this lack of knowledge limits our capacity to intervene effectively to prevent it.
From a medico-legal perspective, issues regarding the nature and severity of mental disturbances and how they may influence the assessment of the offender's degree of criminal responsibility are major concerns associated with filicide.
Thus, child and adolescent homicides require greater medico-legal attention, and improved education for healthcare professionals together with further research is essential to develop effective preventive and therapeutic strategies. In suspected filicide, careful integration of scene

findings, post-mortem examination, ancillary investigations, and psychiatric assessment is essential for accurate reconstruction of the mechanism of death and the overall dynamics of the event. This case highlights the medico-legal value of integrating scene investigation, autopsy, histopathology, toxicology, and forensic psychiatric assessment in the reconstruction of maternal filicide by combined asphyxial mechanisms.

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## Minor or adult? A post-mortem case with conflicting skeletal and dental age indicators and relevant legal implications

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**Introduction**. Forensic age estimation is a key component of contemporary medico-legal practice whenever chronological age carries relevant legal consequences. Although most frequently applied to living individuals in migration procedures, asylum claims, or criminal responsibility assessments, it is equally important in post-mortem investigations aimed at establishing the biological profile of unidentified bodies. In such cases, age at death represents a primary identification parameter.

International guidelines such as those developed by the AGFAD (German Workgroup for Forensic Age Estimation), recommend a standardized multidisciplinary approach combining clinical evaluation (to assess pre-existent conditions that may hamper growth), odontology, and radiology. These recommendations emphasize that no single biological indicator should be interpreted in isolation and that conclusions must derive from the integration of all the developmental markers: commonly examined parameters include ossification of the hand and wrist, mineralization of the third molars, and, in borderline cases (often in late adolescents differentiation between individuals under and over eighteen years of age may no longer be possible), evaluation of the medial clavicular epiphysis [1].

We report a case illustrating these methodological difficulties. A young Algerian male was found deceased in a small stream in Switzerland, near a Federal Asylum Centre where he had been accommodated. According to the date of birth reported in the official Swiss document issued by the State Secretariat for Migration, he was 14 years old. This information was subsequently questioned after the Algerian Consulate supplied a different identity attributed to the deceased, reporting an age of 19 years. Clarification of the biological age was essential to confirm the boy's identity, enabling formal notification of relatives, issuance of the death certificate, consular procedures, and lawful repatriation to Algeria, with implications for civil status, inheritance, and administrative matters.

**Materials and methods**. A complete medico-legal investigation was performed to determine cause and manner of death and biological age. Autopsy was supplemented by histological, toxicological, and radiological analyses, with documentation of secondary sexual characteristics and general somatic development.

Post-mortem computed tomography was conducted to identify traumatic or pathological findings and on a second step to assess skeletal maturation (based on the standards recommended by AGFAD). Hand and wrist development were evaluated using the Greulich and Pyle atlas and the Tise method. The medial clavicular epiphysis was analysed according to established CT staging criteria (Wittschieber et al.). Dental development was independently assessed through radiographic evaluation of third molar mineralization.

All the procedures were carried out according to AGFAD recommendations and to the guidelines of the DGRM and the SGRM (German and Swiss societies for Legal Medicine) [2]. A major limitation was the absence of medical history, including possible endocrine or nutritional disorders influencing growth.

**Results**. Autopsy and histological findings were consistent with death by drowning. No lethal traumatic injuries were detected. Toxicological analyses revealed ethanol, cannabinoids, and benzodiazepines in blood samples. Hair analysis demonstrated prior exposure to multiple substances including cocaine, MDMA, tramadol, THC, benzodiazepines, and quetiapine.

Identification proved complex. Initial fingerprint comparison matched migration authority records corresponding to a fourteen-year-old individual, consistent with Swiss documentation. However, following a repatriation request, the Algerian Consulate asserted that the body belonged to a nineteen-year-old adult without providing independent fingerprint documentation.

Comprehensive age estimation demonstrated incomplete skeletal maturation of the hand, wrist, and clavicle, compatible with minor age status. In contrast, third molar development indicated a high probability that the individual had reached or exceeded eighteen years.

**Conclusion**. This case highlights the intrinsic limitations and possible discordance among forensic age estimation methods in late adolescence. Skeletal findings supported minor status, whereas dental maturation suggested probable majority. Such divergence may reflect conditions delaying skeletal growth with limited impact on dental development [3]. In the absence of medical history, this hypothesis could not be verified. When standardized multidisciplinary methods yield conflicting indicators, age estimation becomes a complex interpretative process requiring scientific prudence, transparency, and careful communication of uncertainty given its substantial legal and humanitarian implications.

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## Not only the heart: autopsy findings and alternative causes in sudden infant death

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**Introduction**. Sudden Infant Death Syndrome (SIDS) is defined as the sudden and unexpected death of an infant < 1 year of age, when complete autopsy, review of the circumstances, and clinical history fail to find a cause. Despite the reduction in incidence in recent decades, SIDS remains one of the leading causes of death between 1 month and 1 year-old infant in industrialized countries, with approximately 250 cases per year estimated in Italy [1]. According to the "triple risk hypothesis," death results from the interaction between an intrinsic vulnerability, a critical developmental period of autonomic control and exposure to an exogenous stressor. Historically, etiopathogenesis has focused on cardiac mechanisms, including conduction system abnormalities and channelopathies responsible for fatal arrhythmias in the absence of structural heart disease. However, recent evidence shifts attention toward infectious and inflammatory mechanisms as relevant contributors to SIDS. Mild viral upper respiratory tract infections are reported in nearly 80% of SIDS cases in the days preceding death [2]. Acute respiratory infections represent the leading cause of infant morbidity and mortality, and numerous studies have demonstrated an association between SIDS and, often paucisymptomatic, viral infection. A plausible hypothesis is that common bacterial toxins, combined with viral infection, may trigger SIDS in a vulnerable infant. This is consistent with the winter incidence peak, the age distribution (increase at 2–3 months old when maternal IgG decline), and the prone sleeping position, which may favor secretion pooling and toxin production in the upper airways [3].
This study presents four autopsy cases of infants under one year old according to a validated protocol at the Legal Medicine of Marche University Hospital, Ancona, Italy.
**Materials and methods**. The Legal Medicine of Marche University Hospital of Ancona has conducted a retrospective review of five infant deaths (<1 year old) between 2016 and 2019 according to a standardized multidisciplinary protocol (Law n. 31/2006, Decree of October 7, 2014).
**Results**. Among five cases initially suspected of SIDS, one was excluded, as the cause of death was a specific infection, and four were classified as SIDS type IB. Inclusion criteria were based on the 2004 San Diego classification (Table 1).

| Case no. | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Age in months | 3.5 | 1.5 | 4 | 5 | 7 |
| Gender | F | M | M | F | F |
| Month | February | February | April | January | April |
| Relevant clinical and scene data | Diarrhoea and respiratory inflammatory signs 15 days before, found dead at 11:00 a.m. | Previously healthy, found dead at 08:30 a.m. | Mild upper respiratory inflammatory signs, found dead at 08:00 a.m. | Previously healthy, found dead at 03:30 a.m. | Mild upper respiratory inflammatory signs 15 days before, found dead at 08:30 a.m. |
| Post-mortem findings | Congested and oedematous lungs, petechiae (thymus, heart, lung), congested internal organs | Congested and oedematous lungs, petechiae (thymus, lung), congested internal organs | Congested and oedematous lungs, petechiae (heart, lung), congested internal organs | Forehead ecchymosis, lip exctoriation, congested and oedematous lungs, petechiae (thymus, | Congested and oedematous lungs, petechiae (heart, lung), congested internal organs |

| | | | | | |
|---|---|---|---|---|---|
| | | | | heart), congested internal organs | |
| Histology | Diffuse panbronchitis, vacuolar degeneration of hepatocytes | Myocardial hemorrhagic foci, diffuse lung congestion, oedema and histiocytes | Diffuse lung congestion, oedema and histiocytes, vacuolar degeneration of hepatocytes | Diffuse lung congestion, oedema and histiocytes, vacuolar degeneration of hepatocytes | Diffuse lung congestion, hemorrhagic oedema |
| Radiology | CT scan-Negative | CT scan-Negative | CT scan-Negative | X-rays-Clavicular fracture | X-rays Negative |
| Microbiology | Human Coronavirus HKU1, Human Rhinovirus | - | - | - | - |
| Toxicology | - | - | Negative | - | Negative |
| Final conclusion | Acute respiratory failure in panbronchitis in viral HKU1 coronavirus and rhinovirus infection | SIDS IB | SIDS IB | SIDS IB | SIDS IB |

**Conclusions**. Our findings indicate that infectious and inflammatory processes, particularly involving the respiratory tract, must be systematically investigated at autopsy. A multidisciplinary autopsy protocol (histology, microbiological screening for major infant bacterial and viral pathogens, molecular techniques) is essential to detect clinically occult inflammatory and infectious conditions. Despite comprehensive post-mortem investigation, the cause of death frequently remains undetermined, reflecting the limitations of post-mortem analysis in detecting functional disturbances and the multifactorial nature of SIDS.

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## On a particular case of undetected asphyxia in a 5-years-old child

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**Introduction**. A 5-years-old boy was found dead in his bed around 1 a.m. by his mother, first responders tried to reanimate the child without success, declaring him deceased. The ambulance doctor inferred for natural cause of death. Due to the uncertain circumstances, Jurisdictional Authority ordered the inspection by his Medical Examiner. The external examination revealed unspecific and non-pathognomonic vital injuries: little linear excoriations on the nose and bruising on the right pinna and maxillary region, with tiny palpebral petechiae. No irrefutable signs of mechanical constriction of the upper airways were found.
**Materials and methods**. Autopsy revealed signs that could be referred to acute asphyxia, including diffuse subpleural petechiae, epicardial petechiae and enhanced blood fluidity due to hypoxemia. Internal examination showed heavy, congested lungs with acute emphysema and an enlarged brain with marked vascular congestion. Histological analysis showed acute pulmonary edema and alveolar septal rupture due to acute hyperaeration. Toxicology was negative for common drugs of abuse and pharmacological substances.
**Results**. Brief research of literature shows how petechiae are way more less present in children which are victims of mechanical asphyxia, this because of lesser defense capabilities, which results in more quick death as a result of the homicidal action; also, the capillary pressure values reached are lower than in adults, this makes it more difficult for petechiae to form. The correct interpretation and comparison of all the data collected finally made it possible to establish both the cause of death, identified in mechanical asphyxiation by smothering, and to clarify the dynamics of the events that occurred.
**Conclusion**. Mechanical asphyxia by smothering represents a challenging diagnostic entity in forensic pathology, especially in pediatric cases where external signs of struggle may be subtle or absent. Thus, the forensic pathologist assessment must be focused on the correlation between circumstantial evidence, external examination, and histopathological findings.

## Patterns of adolescent mortality: a retrospective study from the Institute of legal medicine of Modena (2010–2024)

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**Introduction**. Mortality in pediatric and adolescent populations represents an important epidemiological indicator of a community's health and social conditions. Over recent decades, the reduction in deaths from natural causes has led to a progressive increase in the relative proportion of traumatic deaths among young individuals, including those related to episodes of criminal violence associated with the phenomenon of so-called baby gangs. In this context, medico-legal investigations, and particularly forensic autopsies, play a fundamental role in determining the cause and manner of death and in collecting useful data for epidemiological and preventive purposes.

**Materials and methods**. A retrospective study was conducted on all adolescents aged 10–17 years who underwent medico-legal investigation at the Institute of Legal Medicine of Modena between 2010 and 2024. Medico-legal investigations included external examination, forensic autopsy, and administrative autopsy.

A total of 26 cases were identified and divided into two groups: Group 1 (10–14 years; n = 8) and Group 2 (15–17 years; n = 18).

In Group 1, seven males and one female were identified. In five cases a full autopsy was performed, while in the other three only the external examination was conducted.

In Group 2, which included twelve males and six females; seven autopsies and eleven external examinations were performed.

For each case, age, sex, type of medico-legal investigation performed, mechanism of injury, cause and manner of death, and toxicological findings when available, were recorded and analyzed.

**Results**. Overall, 18 accidental deaths, 4 suicides, 3 natural deaths and 1 homicide were recorded.

In the 10–14-year group (n = 8), one death from natural causes, one suicide, and six accidental deaths (75.0%) were identified. Accidental deaths included one railway run-over, one freshwater drowning, and four road traffic accidents. Toxicological analyses were performed in four cases, with negative results in all cases.

In the 15–17-year group (n = 18), one homicide, two deaths from natural causes, three suicides (16.7%), and twelve accidental deaths (66.7%) were observed. Among the accidental deaths (n = 12), eight were related to road traffic accidents, three to freshwater drowning, and one to acute intoxication due to illicit drug overdose. Toxicological analyses were performed in five cases, with positive findings in four of them.

No clear temporal trend was observed across the study period, with only minor annual fluctuations (some years without cases: 2015 and 2019) and occasional peaks (2013 and 2017), consistent with the episodic nature of traumatic adolescent mortality and with the limited number of cases in our series, which may influence the interpretation of temporal trend.

**Conclusions**. In the analyzed case series, forensic autopsy was performed in 12 cases, whereas 14 cases underwent only external examination of the body.
Although in Italy the homicide rate among minors has remained substantially stable despite an overall decrease in the total number of homicides, male adolescents aged 14–17 years still represent the group at highest risk. Consistently, in our series only one homicide was identified, involving a 16-year-old male victim.
Overall, despite the limited number of cases, a clear predominance of accidental deaths emerged, with a particularly high frequency of road traffic accidents.
The findings also reflect the age-related shift in adolescent mortality described in the literature, with older adolescents showing a higher proportion of violent deaths, including suicide and homicides.
Deaths in adolescence are often characterized by complex circumstances and significant medico-legal implications. In this context forensic autopsy and ancillary investigations are essential to accurately determine the cause and manner of death, reconstruct the events leading to death, and improve epidemiological knowledge in order to support effective prevention strategies for avoidable deaths among adolescents.

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## Paediatric death due to cervical crushing: multidisciplinary assessment of the causal link

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**Introduction.** This is the case of an 8-year-old child who died at home after being crushed by the closing mechanism of a double storage bed. Immediately after the incident, the child's mother called for help and her partner performed CPR. Despite immediate assistance and subsequent hospitalization, the child died in hospital a few days later. Following this tragic event, medical-legal and engineering investigations were carried out to clarify the possible presence of manufacturing defects and the causal link between the mechanical structure and the harmful dynamics.
**Materials and methods.** From a forensic point of view, as no autopsy was performed, the information provided by the medical staff was used to clarify the dynamics of the death. From a clinical point of view, the child presented with a greyish complexion, ecchymosis at the base of the neck and on the right side of the face, absence of breathing, asystole, pinpoint miotic pupils and absence of consciousness that was never regained. The CT scan revealed subcortical punctiform hyperdensities indicative of petechial haemorrhage, oedema and herniation of the cerebellar tonsils through the foramen magnum, and laceration of the fourth lobe of the liver. The engineering investigation involved technical inspections of the home to verify the functioning of the bed and the opening/closing system. The mechanics of the bed, comparable to a second-class lever, and the forces involved were analysed. Metric tests were carried out to measure the crushing force exerted by the bed base and mattress assembly and the force of the pistons installed. The tests were performed with the load at different distances from the fulcrum and at different heights, simulating the position of the child's neck. The technical data were integrated with the medical-legal reconstruction of the dynamics.
**Results.** Although initially it was hypothesized that the neurological damage was of traumatic origin, the information reported by the medical staff corroborated the hypothesis that the predominant mechanism leading to post-anoxic encephalopathy was extrinsic compression of the neck with consequent occlusion of the vessels belonging to the vascular-nervous bundle - nervous bundle, i.e. the carotid arteries and jugular veins, causing hypoperfusion and venous stasis in the cerebral circulation. This hypothesis was supported by findings such as facial cyanosis and subcortical haemorrhagic petechiae, suggestive of rupture of the small vessels of the cerebral venous circulation in response to the increase in pressure induced by blood stasis. These mechanisms were also amplified by the greater compressibility of the cervical structures and the lower resistance of the airways typical of paediatric age. The engineering investigations did not reveal any manufacturing defects in the mechanism; however, the double bed in question was equipped with 500 N pistons, while double models are normally equipped with 1,000 N pistons. At the same time, 1,000 N pistons were installed on one of the queen-size beds in the home, leading to the conclusion that the pistons were likely swapped during assembly. The reduction in thrust resulted in an increase in the critical height beyond which the system remains open and a tendency for the bed base and mattress to fall back automatically once this threshold is exceeded during closure. The chronological compatibility between the mechanical dynamics and the damage pattern ruled out alternative mechanisms.

**Conclusions.** The case in question highlights how an apparently trivial assembly error can substantially alter the mechanical balance of commonly used devices, transforming a harmless device into a source of serious risk.
The integrated analysis of forensic engineering and forensic medicine made it possible to clarify the injury dynamics and establish the causal link between the piston exchange, system instability and lethal cervical compression.

# Pediatric death due to complications of a left hemispheric cerebellar abscess secondary to otomastoiditis from streptococcal otitis media: description of an autopsy case

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**Introduction**. A cerebellar abscess is a circumscribed collection of pus within the cerebellum, generally secondary to bacterial infections. It most commonly originates from otitis media, although it may also arise from hematogenous spread of a distant infectious focus or from a locally developing infection of traumatic origin. The purulent collection can cause significant local inflammation and compress surrounding brain structures, potentially leading to neurological dysfunction, intracranial hypertension and life-threatening systemic complications. We report the case of a four-year-old girl who, in the absence of significant prior medical history, died from complications of a left cerebellar hemispheric abscess secondary to otomastoiditis resulting from streptococcal otitis media.
**Materials and methods**. The reviewed documentation indicated that the patient had been complaining of left ear pain for approximately one month prior to death. The child was initially examined by her primary care pediatrician, who prescribed Anauran ear drops and Paracetamol (Tachipirina). Persistence of symptoms after several days required a clinical reassessment by the same pediatrician, who confirmed the therapy with Anauran. After a further two weeks of almost continuous ear pain, the child was taken to a first Emergency Department because the otalgia had become associated with headache, vomiting episodes and abdominal pain. She was discharged the same evening with a diagnosis of viral illness, but presented to two additional Emergency Departments the following day. At the last facility, a CT scan revealed a left cerebellar hemispheric expansive lesion requiring further evaluation with MRI. The child was therefore admitted to the Pediatric Anesthesia and Intensive Care Unit for close monitoring. The following day, MRI confirmed the presence of a cerebellar abscess and otomastoiditis, more pronounced on the left side. An urgent decompressive craniotomy with placement of an intraventricular catheter was performed and accompanied by the initiation of an antibiotic therapy with Ceftriaxone and Metronidazole. Two days later, abscess fluid cultures tested positive for multisensitive Streptococcus pyogenes, leading to the addition of clindamycin to the ongoing therapy. A progressive clinical deterioration then occurred, culminating two days later in brain death, certified according to legal standards. In order to determine the exact cause of death and assess possible medical liability of the healthcare professionals involved, an autopsy was performed five days after death.
**Results**. External examination revealed findings consistent with the documented surgical and therapeutic procedures, the main ones being a surgical wound in the left retromastoid region and a right paramedian fronto-parietal surgical incision. An incision of the thoraco-abdominal wall attributable to post-mortem multiorgan procurement was also observed. In addition to findings consistent with the surgical procedures and the aforementioned organ procurement, autopsy revealed marked swelling of the cerebellar tissue and a left transtentorial cerebellar herniation. Parenchymal malacia was observed in the left cerebellar lobe and the left inferior temporal region, together with scant yellowish material (likely purulent) within the supra- and subdural spaces of the ipsilateral temporo-cerebellar region. Delayed examination of the brain performed forty-three days later (after formalin fixation) confirmed a necrotic colliquative malacic area in the left cerebellar lobe and the ipsilateral inferior temporal gyrus, as well as

midline asymmetry with a leftward shift and marked brainstem asymmetry with ponto-mesencephalic deviation to the right.

**Conclusion**. Based on the reviewed documentation and autopsy findings, an initial left-sided S. pyogenes otitis media progressed to otomastoiditis, which led to the development of a left cerebellar hemispheric abscess, ultimately triggering a rostro-caudal brain degeneration resulting in brain death. The cause of death was therefore attributed to brain death due to a left cerebellar hemispheric abscess secondary to otomastoiditis evolving from S. pyogenes left otitis media. Several questionable healthcare practices were also identified, the most critical being the failure to prescribe oral antibiotic therapy during the pediatrician's follow-up visit. From a medico-legal perspective, management in accordance with established best practices would have prevented the patient's death with a high degree of probability.

## Pediatric road traffic fatality: reconstruction child occupant position and safety restraint use

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**Introduction**. Road traffic accidents are among the leading causes of traumatic death in children and often pose significant challenges in reconstructing injury dynamics. Determining the child's position within the vehicle and verifying the proper use of safety restraint systems are critical both for understanding the mechanism of injury and for judicial purposes.
This case highlights the importance of integrating autopsy findings, technical analyses, and witness statements to accurately reconstruct pediatric road traffic accidents. Specifically, we report a fatal accident involving a two-year-old child, in which combined data from the autopsy, witness accounts, and technical-reconstructive analyses conducted at the scene and within the vehicle allowed for a highly reliable determination of the child's position and assessment of potential misuse or failure of the car seat.
**Materials and methods**. Forensic analysis focused on the type and distribution of traumatic injuries, paying particular attention to signs consistent with restraint by the car seat.
The case file was reviewed, revealing that the car seat recovered from the scene was appropriate for the child's weight and that its anchorage system and seat belts were fully functional. These findings were compared with statements from the parents and the first responder to evaluate consistency with autopsy results.
**Results**. The accident involved a head-on collision caused by one vehicle crossing into the opposite lane due to excessive speed and poor traction on a wet road. The impacted vehicle carried a family, including the twoyear- old child, who was transported to the Emergency Room in critical condition and died a few hours later despite emergency interventions.
Autopsy revealed massive cranioencephalic trauma, multiple cranial fractures, widespread intracranial hemorrhages, brain parenchymal lacerations, and marked cerebral edema, consistent with high-energy impact of the head against rigid surfaces inside the vehicle. Numerous contusions and abrasions were observed on the head and face, predominantly on the right side. Notably, there were no injuries typically associated with restraint by a properly used car seat, such as patterned thoracoabdominal bruising, linear contusions, anterior rib fractures, or visceral injuries.
The car seat was structurally intact, appropriate for the child's weight, and fully functional. However, the first responder's account conflicted with the parents' statements, as he reported finding the child unconscious, lying face down on the right rear footwell, without having to release any restraint system, and only later noticing the car seat outside the vehicle.
Integrated analysis of these data led to several possible reconstructions of the event.
One scenario suggests the child was in the car seat, rear-facing, but inadequately secured, resulting in impact against the rear seatback and subsequent displacement into the footwell.
Another possibility is that the child was improperly oriented or misused within the seat, projecting forward against the front seatbacks before falling into the rear compartment.
A third scenario considers that the child was not in the car seat but held in the mother's arms, being thrown forward during the collision.


**Conclusion**. Overall, the evidence revealed inconsistencies between the parents' account and the autopsy findings.
The child's position within the vehicle, the absence of injuries consistent with restraint, and the distribution of trauma strongly suggest that the child was not properly secured in the car seat at the time of the accident.

## Pediatric sudden cardiac death associated with congenital coronary artery anomalies: a three-case series

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**Introduction**. Sudden cardiac death is defined as a natural, unexpected fatal event occurring within one hour of symptom onset in an apparently healthy individual [1]. Although congenital coronary artery anomalies are rare, affecting less than 1% of the general population [2], they are a recognized cause of myocardial ischemia and sudden death in children and adolescents. The strength of the association between specific coronary anomalies and fatal outcomes varies: some anatomical variants are considered highly probable or definitive causes of death, whereas for others the causal relationship remains uncertain. This report describes three pediatric cases of sudden cardiac death (aged 19 months, 8 years, and 13 years) associated with previously undiagnosed congenital coronary anomalies.
**Materials and methods**. Two cases underwent forensic autopsy, and one case underwent clinical autopsy. Ancillary investigations included detailed cardiopathological examination (performed on the fresh heart in one case; formalin-fixed in the others), along with histological and toxicological analyses. Microbiological testing was performed in one case, and post-mortem genetic testing in another. Particular attention was devoted to coronary anatomy, including assessment of anomalous origin, course, ostial morphology, and associated structural abnormalities. Integration of autoptic and ancillary findings allowed for the formulation of pathogenetic hypotheses regarding the mechanism of death.
**Results:** All cases showed congenital abnormalities of the coronary circulation. **Case A** (13 years): the patient suddenly collapsed while climbing stairs. Medical history was unremarkable. Emergency medical services initiated resuscitation, which was continued for approximately 40 minutes; he was subsequently transported to the emergency department, where death was pronounced. Clinical documentation showed ventricular fibrillation and subsequent cardiac arrest; autopsy revealed a left anterior descending (LAD) intramyocardial bridge and distal hypoplasia of the LAD and left circumflex (LCx) arteries. Histologically, multifocal acute ischemic injuries were found. **Case B** (8 years): the child collapsed during football training, and despite prompt basic life support, he was pronounced dead. An automated external defibrillator was available on site but not used, and advanced life support arrived after ~15 minutes. Prior resting ECG and echocardiography (5 years earlier) were reportedly normal; parents reported two self-limited episodes of dyspnea in preceding months. Autopsy showed anomalous origin of the left main coronary artery from the right coronary sinus (separate ostium from the right coronary artery) with a retroaortic course, a slit-like ostium with acute take-off, and hypoplastic LAD and LCx; histology demonstrated acute ischemic foci with features consistent with prior ischemic/reparative injury. **Case C** (19 months): the infant was found unresponsive in the crib after feeding. Autopsy identified a high take-off coronary origin with acute-angle emergence and a short intramural/intra-aortic segment, mild ascending aortic dilatation without substantial histologic wall changes. The molecular analysis showed KCNQ1 exon 1 variant of uncertain significance; no alternative non-cardiac cause of death was identified.
**Conclusion**. Across these three pediatric sudden death cases, post-mortem investigation identified congenital coronary artery anomalies, some traditionally regarded as low or

uncertain risk (e.g., retroaortic course, high take-off), that were nonetheless associated with acute ischemic injury and presumed fatal malignant arrhythmias, occurring both at rest and during physical exercise. These findings highlight the diagnostic challenges posed by coronary anomalies, particularly when adverse anatomical features coexist (slit-like ostium, acute take-off angle, intramural segment, distal hypoplasia) and when histology reveals prior ischemic or reparative changes. Overall, these cases emphasize the diagnostic complexity of coronary anomalies, the potential risk amplification associated with combined anatomical abnormalities and the importance of a multidisciplinary approach - including forensic pathology, cardiology, and genetics - in the evaluation of pediatric sudden cardiac death.

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## Sudden and unexpected death in a 2-month-old infant with congenital tracheal stenosis and bilateral arcuate nucleus agenesis

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**Introduction**. Congenital tracheal stenosis (CTS) due to complete tracheal rings with absence of the pars membranacea is rare and potentially lethal in infancy. Agenesis/hypoplasia of the medullary arcuate nucleus (ARC) - a chemosensitive component of the ventral medullary surface - has been implicated in disordered respiratory control in sudden perinatal and infant deaths. The concurrence of these two anomalies is uncommon.

We report a rare, isolated case of CTS in a 2-month-old infant with complete rings and absent pars membranacea associated with bilateral ARC agenesis, resulting in sudden death during sleep.

**Materials and methods**. A full forensic autopsy was performed on a 2-month-old male infant found unresponsive in his parents' bed. The investigation included a detailed review of the clinical history (noting maternal obesity and tobacco use) and a systematic external and internal examination.

Comprehensive toxicological analyses were conducted on multiple biological matrices to screen for a broad range of exogenous substances and xenobiotics.

Finally, a targeted histological analysis was performed on the respiratory system and the brainstem, with specific focus on the tracheal structure and the medullary arcuate nucleus.

**Results**. External examination showed diffuse cyanosis and minor superficial abrasions without signs of significant trauma. Internal findings revealed heavy, congested lungs with petechiae and cerebral edema; the heart and great vessels appeared normal, and the ductus arteriosus was closed.

Toxicological screenings were negative.

Histological analysis confirmed the presence of congenital tracheal stenosis characterized by complete cartilaginous rings and the total absence of the pars membranacea. Simultaneously, the brainstem examination revealed bilateral agenesis of the medullary arcuate nucleus.

These combined findings supported a diagnosis of acute hypoxic-ischemic death during sleep.

**Conclusion**. This case describes a rare, isolated CTS with complete rings and absent pars membranacea co-existing with bilateral ARC agenesis, providing a clear organic explanation "cum materia" for sudden unexpected death in infancy (SUDI).

This case report may serve as an initial steppingstone toward enhancing scientific understanding and the impact of bilateral arcuate nucleus agenesis.


By reporting this rare condition, our study encourages further investigation into cases where it co-occurs with other life-threatening abnormalities, such as congenital tracheal stenosis due to a complete cartilage ring. Identifying and characterizing these associations is crucial, as they may significantly reduce survival chances.

Future research building on this foundation could improve diagnosis, guide clinical management, and ultimately contribute to better outcomes for affected individuals.

## Sudden death in a child with suspected low-voltage electrocution: a forensic case investigation

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**Introduction**. Cases of death due to suspected electrocution pose significant challenges for forensic investigation, particularly in unwitnessed cases and/or when reliable circumstantial information is missing. In this context, the most relevant morphological finding to guide the diagnosis is the "electrical mark", which is not consistently present in electrocution cases. The diagnosis becomes even more controversial when low-voltage current is involved, since in such cases electrocution rarely produces detectable tissue changes (such as electrical marks or burns) but mainly induces fatal arrhythmias [1]. For these reasons, deaths due to electrocution may be misclassified as natural sudden cardiac deaths, according to the most recent guidelines [2, 3].
We present the case of a 6-year-old child who was found dead during a baptism celebration with his family. He was discovered unconscious on the steps of a staircase. Emergency medical services were contacted shortly afterwards, and the child was transported to the emergency department, where he was declared dead. Suspicion of electrocution arose when several people attending the celebration reported experiencing an electric current when placing their hand on the handrail of the staircase where the corpse of the child was found.
**Materials and methods**. A forensic autopsy followed by histopathological examination was performed with the support of a cardiovascular pathologist. Tissue specimens obtained during the autopsy were sampled and stained with hematoxylin and eosin, according to standard histopathological protocols, and with Mallory's trichrome stain, for the evaluation of possible myocardial abnormalities. Some samples were included and sectioned without staining, in order to assess the possible presence of inorganic inclusions within the tissues. For the medico-legal assessment of the case, all available documentation was reviewed, including witness statements and the results of an engineering assessment of the staircase where the child was found.
**Results**. The engineering assessment of the staircase confirmed the presence of a 220-volt electrical current along the handrail. The forensic autopsy revealed three round, blackish lesions on the palm of the right hand, approximately 0.2 cm in diameter, interpreted as the point of entry of the electric current. Acute pulmonary emphysema, intra-alveolar hemorrhage, and cerebral edema were also observed. The histopathological evaluation of the palmar lesions showed a normal morphology of the stratified squamous epithelium with a thick stratum corneum. Epidermal ridges were preserved with no evidence of epidermal or dermo-epidermal detachment, necrosis, or tissue homogenization. In correspondence with the previously described blackish round lesions, a circumscribed focus of vascular congestion was identified. No histological features constitutive of the "electrical mark" were detected. The cardiopathological examination revealed a structurally normal heart, with no evidence of malformations, congenital disease, or myocardial pathology. However, small hemorrhagic extravasations were identified within the subepicardial tissue of the right atrium, proximally to the atrioventricular node. Other non-specific findings, including intramyocardial micro-hemorrhagic foci and focal areas of hyper-eosinophilia were also observed.

**Conclusion**. The electrical current measured in this case was regarded as a sufficient external traumatic agent to cause a non-natural sudden death, since even low-voltage currents (110–380 V) may induce arrhythmias, including asystole and ventricular fibrillation [1]. Taken together, the findings from the medico-legal investigation, the engineering assessment conducted at the scene, and the circumstantial evidence were considered compatible with death due to electrocution. Conversely, given the low incidence of sudden cardiac death in children (10 to 100 times lower than in adults) and the absence of structural cardiac abnormalities and/or congenital myocardial disease at autopsy and histopathological examination, the hypothesis of a natural cardiac death was considered unlikely.

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## Sudden infant death: natural or accident? A case report

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**Introduction**. Sudden unexpected infant death (SUID) is defined as a sudden and unexpected death of a child under 1 year of age. If the cause of death remains unexplained after a complete investigation, autopsy and laboratory testing, the event is referred to as sudden infant death syndrome (SIDS). Both SUID and SIDS represent difficult challenges for the forensic pathologist, as we are still far from a complete understanding of the pathologic mechanisms involved in these cases. The authors present a case of a sudden unexpected infant death where a complete autopsy and thorough testing was able to identify a cause of death and rule out any fault on the part of the parents.

**Materials and Methods**. In November 2024 a mother of three was carrying her children to school on a crowded bus. The oldest child walked by himself, the middle one was in a baby carrier, and the youngest, a five-month-old male, was secured on her back by a small blanket, facing towards the mother. After dropping the two older children at school, the mother placed the infant, who was apparently sleeping, in the baby carrier and returned home. When she placed the infant in the crib, she noticed he was unresponsive and called emergency services. On their arrival, no pulse was detected and, despite prolonged resuscitation maneuvers, the infant was pronounced dead shortly after. A review of the medical records regarding pregnancy, birth and subsequent medical exams of the infant revealed no anomalies or risk factors for sudden death.

The state prosecutor requested a full autopsy, under suspicion that the death was a consequence of an unsafe family environment or the way the infant had been carried during the bus ride. Because of the young age of the infant, and the delicate nature of the case, an anatomopathological consultation was also requested.

**Results**. At autopsy, no pathological gross findings or gross malformations were identified. The microscopic investigation of the heart, however, revealed diffuse fibrosis of the sinoatrial node. Additionally, the His bundle was completely divided by a fibrosis band at the emergence of the right branch. Both anomalies were first observed using hematoxylin and eosin stain and then confirmed using Masson's trichrome stain. A systemic mild inflammatory state was also detected, involving the upper and lower airways, lungs, gastrointestinal tract, and bladder. Eosinophils and mast cells infiltration was identified in multiple organs. The cause of death was attributed to a malignant cardiac arrhythmia, and the manner of death was defined as natural, excluding any correlation with the back carrying method.

**Conclusion**. The presented case adds to the body of evidence regarding the role of inflammation, alone or in association with pre-existing risk factors, in sudden infant death. It also highlights the need for a thorough examination of the case and collaboration between different medical experts in order to correctly define the cause of death in these complex cases.

## Sudden unexpected death in a preschool child: a case report of acute myocarditis on left ventricular hypertrophy

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**Introduction**. Acute myocarditis is an inflammatory disease of the myocardium that may be primary - most commonly related to acute viral infection or post viral immune response - or secondary to infectious agents, systemic disorders, drugs or toxins.
In children, its early manifestations are frequently subtle and nonspecific: fever, gastrointestinal or respiratory symptoms, asthenia, tachycardia or arrythmias may precede catastrophic deterioration, often mimiking benign viral illness. In forensic practice, myocarditis represents a recognized cause of sudden unexpected death in the young, accounting for approximately 5-12% of cases. Fulminant forms may precipitate abrupt hemodynamic collapse in previously healthy subjects.
We report a case of sudden death in a 4-year-old child in whom autopsy and histopathological investigations identified acute myocarditis developing on a substrate of left ventricular hypertrophy (LVH).
**Materials and Methods**. A previously healthy 4-year-old boy was found unresponsive at home early in the morning, after three days of fever and gastrointestinal symptoms treated symptomatically. Resuscitative maneuvers were unsuccessful.
Autopsy was performed approximately 24 hours after the death and including sampling for microbiological and histopathological analyses. Cerebrospinal fluid (CSF) was tested by Real Time PCR for Neisseria meningitidis and Streptococcus pneumoniae. Tissue samples from heart, brain, lungs, liver, spleen, kidneys, pancreas and adrenals were examined using hematoxylin-eosin staining. Toxicological samples were collected and preserved according to forensic standards.
**Results**. External examinations revealed a well-developed child without signs of trauma. The cadaveric dissection showed cerebral edema and diffuse multivisceral congestion. The lungs displayed marked edema and congestion on the right side, while the left lung appeared modestly emphysematous; subpleural petechiae were present on the left. The heart weighed 110 gr, increased for the child's age, with left ventricular wall hypertrophy (anterior wall 1.0 cm; posterior wall 1.5 cm) and subepicardial petechiae; coronary arteries and cardiac valves were macroscopically normal.
Small food residue was found within the trachea, without evidence of obstructive asphyxia.
Histological analysis demonstrated focal acute myocarditis characterized by a polymorphous inflammatory infiltrate, predominantly lymphocytes with plasma cells and rare macrophages, associated with myocyte damage. Pulmonary samples confirmed edema and congestion. The liver showed focal micro and macrovesicular steatosis (<10%). The spleen exhibited red pulp expansion with marked white pulp atrophy. Brain sections showed vascular congestion without focal lesions. No significant pathological findings were observed in the pancreas or intestine. CSF microbiology was negative for N. meningitidis and S. pneumoniae.

**Conclusion**. Death was attributed to acute left ventricular failure secondary to acute myocarditis in a child with pre-existing left ventricular hypertrophy. Bacterial meningitis was excluded by microbiological testing. The pathological mechanism is consistent with acute inflammatory myocardium involvement, histologically documented, superimposed on a structural cardiac substrate abnormal for age, favoring rapid terminal pump failure. The precise etiological agent responsible for the acute myocardial inflammatory process cannot be definitively identified. However, in light of the clinical history of febrile gastrointestinal illness and the absence of evidence for bacterial infection or toxic exposure, the findings are coherently compatible with a probable viral origin, possibly originating from an enteric infection with subsequent systemic spread to the myocardium.

## Suspected COVID-19 after alleged emergency department mismanagement: an infant death case of alveolar capillary dysplasia

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**Introduction**. Sudden unexpected infant death occurring shortly after emergency department discharge may initially raise concerns of diagnostic omission and professional liability. This issue becomes even more challenging when postmortem histology shows interstitial inflammatory changes potentially overlapping, in the early pandemic setting, with patterns suspicious for viral infection. We report a forensic case in which an apparent diagnostic error scenario was ultimately reframed as death due to a rare congenital pulmonary developmental disorder.
**Materials and methods**. A male infant, aged 1 month and 21 days, was found lifeless in bed by his parents on 31 January 2020. The day earlier he had been evaluated in the emergency department for nasal obstruction and discharged with conservative advice, in the absence of overt respiratory distress. Because of the recent discharge, the forensic investigation initially focused on possible professional liability. We reviewed judicial records, pre- and postnatal clinical documentation, emergency department records, death-scene information, and resuscitation reports. A complete forensic autopsy was performed with extensive sampling for histopathology, microbiology, and ancillary investigations. Histological evaluation included routine microscopic examination and targeted immunohistochemical stains to characterize the pulmonary parenchyma, inflammatory infiltrates, and alveolo-capillary architecture.
**Results**. Gross autopsy showed abundant tracheobronchial foamy mucus, diffuse pulmonary petechiae, and no traumatic lesions or major malformations. Histology disclosed bilaterally diffuse lung immaturity with wide areas of atelectatic and poorly developed alveoli, thickened edematous septa, and capillaries abnormally distant from the alveolar epithelium, resulting in structurally ineffective gas exchange. Reactive type II pneumocyte hyperplasia and focal interstitial lymphomonocytic pneumonia with septal hemorrhagic extravasation were also observed. At a time when COVID-19 was emerging, the inflammatory pattern initially suggested the possibility of a SARS-CoV-2-related process; however, the overall microscopic picture proved instead to be consistent with alveolar capillary dysplasia, a rare genetically determined developmental lung disease. Death was therefore attributed to acute hypoxia due to subtotal pulmonary anectasis in alveolar capillary dysplasia, with superimposed interstitial pneumonia acting as a precipitating/aggravating factor.
**Conclusion**. This case highlights how forensic pathology may overturn an initial hypothesis of professional liability after emergency department discharge, especially in high-alert epidemiological periods. In infant deaths with nonspecific premortem symptoms and postmortem interstitial pulmonary inflammation, rare congenital disorders such as alveolar capillary dysplasia must remain in the differential diagnosis. The case is of particular medico-legal interest because a seemingly avoidable death was ultimately explained by an underlying lethal natural disease, recognizable only through integrated autopsy and histopathological assessment.

## The wolf and the pack: a criminogenic analysis of a minor's homicide

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**Introduction**. After a witness report, the corpse of a 17-years-old boy was found concealed among the vegetation inside a public park. On a first external exam of the body was already clear that the lethal action was carried out with extreme violence using a knife, as the numerous stab wounds on the back and the right side of the body indicates. The body was concealed right after the homicide and found only after several hours. This because the aggressors, along with the witness and other members of the group which did not take part in the assault, proceeded to spend the rest of the day on the beach, meanwhile hiding the murder weapon in the sea.
**Materials and methods**. The autopsy revealed a total of 25 stab wounds, nine on the back near the chest and 16 on the right side of the body, distributed between the chest and abdomen. As expected, the lungs showed multiple stab and slash wounds with bilateral hemothorax; however, only a minimal amount of blood was found in the abdominal cavity, despite the liver showing multiple knife injuries. The cause of death was identified as hemorrhagic shock. It is estimated that death occurred a few minutes after the attack.
**Results**. The most disturbing finding from the investigation concerns the suspects' behavior after the crime. The image of young men who, after stabbing a peer twenty-five times, go to a beach club for a swim vividly illustrates what scientific literature describes as an empathic void. Furthermore, in this case, the role of the group served as a powerful multiplier of aggression. The presence of passive witnesses and silent accomplices activates the mechanism known as diffusion of responsibility. Within the "pack", the individual experiences a kind of moral anesthesia: because the blame is distributed among everyone present, ultimately it seems to fall on no one. The group thus creates a collective "bubble" of omnipotence within which the norms of civil society are suspended in favor of a brutal and primitive internal code.
**Conclusion**. The rise of violent crimes and their brutality among the youth, especially among minors, is a serious cause for concern. In these cases, forensic and criminal investigations cannot fail to take into account the criminogenic aspects, which in fact play an equally important role, in understanding both the dynamics and the causes of the events that occurred, thus being able to not only solve the case but also provide a complete and exhaustive interpretation of it, as well as of the phenomena from which they originate.

## When a Fracture Is Not a Fracture: Cranial Bone Overlapping in a Macerated Foetus and Forensic Implications

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**Introduction**. The medico-legal assessment of foetal intrauterine death (FID) represents a major diagnostic challenge, particularly in cases of prolonged intrauterine retention with advanced maceration. Autolytic and liquefactive processes may profoundly distort foetal morphology, potentially mimicking traumatic lesions and leading to erroneous forensic interpretation with significant legal implications [1,2].

**Materials and methods**. We present a case of intrauterine death in an unrecognised pregnancy, investigated at the request of the judicial
authorities. A female foetus presenting with a suspected "skull fracture", initially reported by attending medical
staff, underwent total-body radiography, complete autopsy with systematic dissection, comprehensive histopathological sampling, and detailed placental examination. Particular attention was devoted to evaluation
of the central nervous system.

**Results**. Severe maceration was observed at external examination, characterised by diffuse epidermolysis, cranial bone overlapping with anteroposterior flattening and ligament laxity. Post-mortem radiography demonstrated no fracture lines. Autopsy confirmed integrity of the cranial vault and absence of traumatic lesions. Cranial deformation was attributable to disintegration of fibrocartilaginous sutures tissue and secondary bone mobility during advanced maceration. The brain appeared markedly liquefied with loss of anatomical landmarks, consistent with an estimated intrauterine retention of at least 10–15 days. Histological analysis excluded major congenital anomalies of primary organ pathology. Placental examination revealed severe chronic maternal vascular malperfusion, including long-standing ischaemic infarctions, obliterative vasculopathy of the stem villi and decidual thrombosis, supporting a hypoxic-ischaemic mechanism of foetal death.

**Discussions**. This case highlights the principal interpretative pitfalls in the forensic evaluation of macerated foetuses. Cranial bone overlapping may simulate traumatic injury, making differentiation between vital fracture and postmortem deformation essential in judicial contexts. Accurate diagnosis requires systematic integration of radiological, autopsy and histopathological findings [3]. In the present case, the initial suspicion of violence concerned the parents and was subsequently redirected toward mishandling by the healthcare staff

involved, further emphasizing the medico-legal complexity of the assessment. Advanced brain liquefaction significantly limits morphological assessment of the central nervous system and increases the risk of diagnostic artefacts with potential medico-legal implications.

**Conclusions**. In cases of FID with advanced maceration, only a multidisciplinary and methodologically rigorous approach allows reliable exclusion of exogenous trauma and accurate identification of maternal-placental hypoxicischaemic aetiologies. Cranial alterations in macerated foetuses should be interpreted with pathophysiology framework of intrauterine autolysis rather than presumed evidence of violence. An innovative brain extraction technique preserving the meninges and using fixation in acidified alcohol-formalin solution, currently under methodological evaluation, may improve tissue preservation, reduce parenchymal manipulation and increase the proportion of evaluable cases. Standardisation of such protocols may enhance diagnostic reliability and strengthen medico-legal conclusions in case of foetal death.

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# Poster

## *Open Topic*

## Beyond classical evisceration: is forensic autopsy a result-oriented practice?

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**Introduction**. In the absence of a uniform standard regarding autopsy technique, the evaluation of specific anatomical districts may prove particularly challenging for the forensic pathologist. This study aims to answer to the following question: is forensic autopsy a result-oriented practice? How long can we afford the lack of standard of practice and certification of skill?

We analysed two cases of suspected medical malpractice. In both cases, based on the available clinical and anamnestic information, it was hypothesized that the patients' deaths were attributable to massive haemorrhage originating from injury to arteries supplying the gastroenteric system. This anatomical district is generally underexplored during autopsies performed using "classical" techniques[1]. For this reason, injuries involving the vascular apparatus of the digestive system may go unrecognized.

**Materials and Methods**. Two cases of suspected malpractice will now be described: both patients underwent autopsy and the employed technique consisted of en bloc removal of the abdominal district, followed by formalin fixation and hardening of the digestive tract of interest.

The first case (#1) is about an 82-year-old man who underwent pancreaticoduodenectomy with single-loop reconstruction for pancreatic malignancy. After an initially uneventful postoperative course, on the 14$^{th}$ postoperative day he developed haemorrhagic shock. The abdominal CT performed at that time demonstrated hemoperitoneum but failed to identify the bleeding source. The man died shortly after, due to rapid clinical deterioration. Autopsy was performed, during which access to the abdominal cavity confirmed the presence of hemoperitoneum, with more than 1500 cc of frankly haemorrhagic fluid in the peritoneum. Afterwards the surgical findings of pancreaticoduodenectomy with triple anastomosis (gastrojejunostomy, biliodigestive anastomosis, and pancreaticojejunostomy) were observed. The intestinal loop distal to the gastrojejunostomy was linearized in order to assess wall integrity and inspect the endoluminal content, which consisted of abundant blood material, extending for approximately 120 cm. Subsequently, the esophago-gastro-hepato-pancreatic tract and its vascular axis were removed en bloc. Preliminary evaluation of the surgical sites demonstrated adequate integrity of the gastrojejunostomy and biliodigestive anastomosis. In contrast, the pancreatic remnant appeared haemorrhagic, reduced in consistency and with detached sutures at the termino-lateral pancreaticojejunostomy. The entire block was then subjected to formalin fixation.

The second case (#2) is about a 56-year-old man who presented to the emergency department with abdominal pain and hematemesis associated with hemodynamic instability. Emergency abdominal CT revealed hemoperitoneum, likely originating from the digiunal artery. The patient underwent exploratory laparotomy with haemostasis of the digiunal artery. The postoperative course was complicated by rapidly progressive multiorgan failure, resulting in death. Autopsy was performed, during which access to the abdominal cavity through the surgical sutures reveal no hemoperitoneum. In situ exploration of the abdominal organs showed no macroscopic abnormalities; therefore, the intestinal tract from the duodenum to the proximal jejunum, including the entire abdominal aorta and pancreas, was removed en bloc and formalin fixed.

**Results**. In the #1 case, the examination of the fixed block showed small clots at the hepatic hilum. The celiac trunk was then identified and carefully dissected, with isolation of the splenic artery, the gastroduodenal artery and the hepatic artery. The hepatic artery showed circumferential haemorrhagic infiltration along its entire course; a clot approximately the size of a chickpea was adherent to the wall of the common hepatic artery at 1.5 cm from its origin. This is consistent with the literature describing postpancreatectomy late hemorrhagic complications [2].

In the #2 case, the examination of the fixed block revealed a haemorrhagic infiltration of the omentum in correspondence of the origin of the superior mesenteric artery. Complete isolation of the aorta and its branches was therefore performed. In particular, isolation of the digiunal artery allowed visualization of the surgical site with properly positioned sutures from the exploratory laparotomy. It also enabled identification of a post traumatic pseudo-aneurysm in close proximity to the surgical site as the primary source of bleeding[3].

**Conclusions**. The results highlight that the diagnostic yield of a forensic autopsy is strictly dependent on the technical skill of the pathologist, the choice of dissection method, and a thorough knowledge of surgical anatomy and vascular relationships. In malpractice cases, where the object of medico-legal evaluation often coincides with the surgical field, incomplete exploration may result in missed lesions and inconclusive assessments. These observations raise a broader methodological issue: should forensic autopsy practice remain characterized by technical variability, or should it move toward standardized operative protocols, quality control systems, and post-graduate certification of advanced dissection competencies? In this perspective, forensic pathology cannot be interpreted merely as an obligation of means. Rather, in the context of judicial evaluation, it must aim at achieving the most complete and technically reliable result possible, regardless of the specific technique employed. The method may vary according to resources and circumstances; however, the objective - the exhaustive identification of relevant pathological findings - should not. The present cases therefore support the need for discussion within the scientific community regarding: the development of technical guidelines for complex autopsy scenarios, the formalization of best practices in surgical-field examination, the introduction of structured post-specialization training and certification pathways.

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## Beyond morphology: the diagnostic impact of postmortem microbiology in two forensic infectious deaths

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**Introduction**. Postmortem microbiology (PMM) represents an increasingly valuable tool in forensic pathology, particularly in sudden or unexpected deaths where infectious causes may be underestimated or not clinically recognized. Although traditionally approached with caution due to concerns regarding contamination and postmortem bacterial translocation, current evidence highlights that, when integrated with autopsy findings and histopathology, PMM can significantly contribute to cause-of-death determination [1].
The aim of this work is to illustrate the diagnostic role of PMM through two forensic cases in which microbiological investigations were decisive for establishing the cause of death.
**Materials and Methods**. A retrospective forensic case series including two adult subjects undergoing complete medico-legal autopsy was performed. Case 1 involved a 58-year-old man admitted to the emergency department with clinically diagnosed pneumonia who died the following day despite hospitalization. Case 2 concerned a 57-year-old woman found dead at home after reporting otalgia in the days preceding death.
In both cases, full autopsy, histological examination, and targeted postmortem microbiological analyses were carried out. Microbiological results were interpreted within a multidisciplinary forensic framework integrating clinical history, macroscopic findings, histopathology, and laboratory data.
**Results**.
Case 1 — Staphylococcus aureus pneumonia
Autopsy revealed fibrino-purulent pleuritis and severe necrotizing hemorrhagic bronchopneumonia. Histology confirmed extensive inflammatory and necrotic pulmonary damage. Postmortem microbiology identified a Panton–Valentine leukocidin (PVL)-positive Staphylococcus aureus strain as the etiological agent, supporting the diagnosis of fulminant bacterial pneumonia as the cause of death.
Case 2 — Streptococcus pyogenes meningoencephalitis
Autopsy showed purulent exudate involving the brainstem, medulla oblongata, and cerebellar surfaces, associated with cerebral edema and signs of intracranial hypertension. Histological analysis demonstrated acute and chronic inflammatory infiltrates involving meninges, vascular structures, cranial nerves, and parenchyma, with arteritis and fibrinoid necrosis. Postmortem microbiological investigations identified Streptococcus pyogenes, confirming fatal bacterial meningoencephalitis.
In both cases, PMM findings were concordant with anatomical and histopathological evidence and were essential to establish the final cause of death.
**Conclusions**. These two forensic cases highlight the crucial diagnostic contribution of postmortem microbiology in identifying fatal infections and refining cause-of-death attribution. Consistent with current forensic literature, microbiological findings acquire diagnostic significance only when interpreted within a multidisciplinary framework integrating autopsy, histology, and circumstantial data [1].

PMM may be decisive not only in sudden unexpected deaths but also in clinically investigated cases, allowing identification of specific pathogens and supporting accurate forensic conclusions. Similar forensic reports have demonstrated how PMM can clarify infectious deaths when conventional autopsy findings are nonspecific or incomplete [2,3].
These observations reinforce the importance of standardized sampling protocols and integrated interpretation in routine forensic practice.

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## Cell-type-specific inflammatory patterns in acute ischemic heart disease revealed by osteopontin and NLRP3 in forensic autopsy hearts

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**Introduction**. Sudden death due to acute ischemic heart disease (AIHD) remains a significant challenge in forensic pathology, especially when conventional macroscopic and histopathological findings are subtle or equivocal. Myocardial ischemia triggers heterogeneous inflammatory responses involving both infiltrating immune cells and stressed cardiomyocytes. This study focuses on two molecules with distinct biological origins: osteopontin (OPN), associated with macrophage-related immune activation, and NLRP3, reflecting cardiomyocyte-derived autoinflammatory signaling. The goal was to characterize the cell-type-specific inflammatory architecture of the ischemic myocardium to provide complementary molecular pathological information for postmortem diagnosis.

**Materials and Methods**. This retrospective study included 78 forensic autopsy cases (51 males, 27 females) with a postmortem interval (PMI) of less than 72 hours. The cases were divided into 39 AIHD cases (showing signs of early ischemia like contraction band necrosis) and 39 non-AIHD controls. Myocardial tissues were analyzed using immunohistochemistry and double-color immunofluorescence to identify OPN and NLRP3 expression and their cellular localization. OPN+ cells were counted in five random fields, while NLRP3 expression was evaluated using a semiquantitative grading system (0–3). Statistical significance was determined using a two-sided unpaired Student's t-test, and correlations with background factors were assessed via Pearson's coefficient.

**Results**. The AIHD group showed a significant increase in OPN-positive cells compared to controls ($p = 2{,}87 \times 10^{-10}$), with expression primarily localized to CD68+ infiltrating macrophages. Similarly, NLRP3-positive areas were significantly expanded in AIHD hearts ($p = 4{,}04 \times 10^{-10}$), with expression predominantly observed in N-cadherin+ cardiomyocytes. Both OPN and NLRP3 showed a moderate positive correlation ($r = 0{,}452$) with contraction band necrosis, a marker of acute ischemic change. Notably, neither marker showed a significant association with age, sex, or postmortem interval, indicating their stability as quantitative indicators.

**Conclusion**. The study demonstrates that OPN and NLRP3 reflect distinct, cell-type-specific inflammatory responses - immune cell-mediated and cardiomyocyte-derived, respectively. Their combined evaluation provides complementary molecular pathological information that bridges the gap between conventional histology and molecular pathology. This dual-marker approach represents a promising strategy to support the postmortem interpretation of AIHD, particularly in forensic cases where traditional morphological findings are limited or ambiguous.

## Findings of death due to hypothermia: from myth to reality

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**Introduction**. In the scientific literature, several autopsy findings are described for the diagnosis of death by hypothermia. The macroscopic findings include diffuse light-red hypostasis, skin discoloration, oedema of the lower limbs, perniones (or chilblains) on the body, increased blood viscosity, cardiac dilation, Wischnewsky spots, and subendocardial haemorrhage. Histologically, visceral congestion, acute pancreatitis, pulmonary oedema, perivascular haemorrhages, fat vacuoles of the renal tubules, microthrombi in peripheral vessels, thyroid follicular colloid depletion, and fatty degeneration of cardiomyocyte cytoplasm are described [1, 2, 3]. In forensic practice, however, such findings are not always present. We therefore sought to examine, in some cases brought to our attention, the extent to which one can actually rely on these indicators in day-to-day forensic practice.
**Materials and methods**. The study analysed cases in which a post-mortem examination was requested to investigate the cause of death, occurring between 2010 and 2026. The cases involved five women who were found dead in very cold weather conditions. Given the circumstances of the discovery and the suspicion that the deaths were caused by hypothermia, particular attention was paid to the macroscopic and microscopic findings reported in the literature. A full post-mortem examination was carried out, accompanied by toxicological and histological tests.
**Results**. In the five cases examined, the classic signs associated with hypothermia as described in the literature were not observed. On external examination, the skin appeared mostly pale and pink, whilst there was no eyelid oedema or bluish or reddish skin discolouration. In two cases, maceration of the skin on the soles of the feet was observed, associated with wet clothing.
No cerebral haemorrhagic spread was observed during the post-mortem examination. Wischnewsky's spots were not detected in any of the cases. In all five cases, however, cardiac chamber dilation was documented, predominantly in the right ventricles.
Histological examination revealed polyvisceral blood stasis in all cases, with no evidence of degenerative fatty vacuolisation, microthrombosis, or pancreatitis. Relevant pulmonary oedema was observed in only one case; in the remaining cases, it was at an early stage. In four of the five cases, alcohol was detected in blood, with concentrations exceeding 2 g/L in two. The cause of death was ultimately confirmed as hypothermia in all five cases, although in one of these cases, alcohol intoxication was identified as a contributing factor.
**Conclusion.** The diagnostic challenge in cases of hypothermia lies in the absence of clear, consistent indicators, making it essential to adopt an integrated methodological approach that combines analysis of the clinical picture, the environmental context, and forensic findings.
The literature indicates that the morphological changes described above may be largely absent in cases of rapid, fatal hypothermia. On the other hand, the five cases analysed certainly do not constitute a significant sample. However, these are the cases that actually come to the attention of the forensic pathologist, and it is remarkable that in virtually none of them were any signs suggestive of hypothermia found. The only findings were observations such as dilation of the heart chambers and multi-organ congestion, which are, however, non-specific.


It should therefore be noted that, in the forensic context, a diagnosis of fatal hypothermia is primarily a diagnosis of exclusion, given the frequent non-specific nature of post-mortem findings; in such cases, circumstantial evidence plays a fundamental role, without which it is rather difficult to establish a plausible cause of death.

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# Filamin C (FLNC) truncating mutation in a fatal arrhythmogenic left ventricular cardiomyopathy (ALVC)

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**Introduction**. Sudden death (SD) is defined as a "natural, unexpected fatal event occurring within one hour from the onset of symptoms in an apparently healthy subject" or "in one whose disease was not so severe as to predict an abrupt outcome or occurring within 24 hours in case of unwitnessed event and a victim known to be healthy prior to death.

Forensic pathologists can be the first professionals facing SD, but the support of a multidisciplinary team (e.g. experts in cardiology, toxicology) is frequently needed to determine the cause of death, since the autopsy results may be unremarkable. Genetic analysis may be relevant, both in achieving a diagnosis and in activating targeted familial screening.

Arrhythmogenic cardiomyopathy (ACM) is an important cause of SD and it is characterized by a progressive fibrotic or fibro-fatty replacement of the myocardial tissue.

Three variants of ACM have been identified according to the ventricular involvement: classic arrhythmogenic right ventricular cardiomyopathy (ARVC), a biventricular pattern and a form with an isolated left ventricular involvement (arrhythmogenic left ventricular cardiomyopathy [ALVC]), which turns out to be particularly rare

**Case report**. An apparently healthy Caucasian man aged 37 was found dead in his bed. He had no significant medical, drug-taking or family history and was previously asymptomatic.

**Results**. At autopsy, foci of epicardial and mid-wall fibrous and fibroadipose tissue were observed within the mid-apical lateral and posterolateral walls of left ventricle (LV) and, albeit to a lesser extent, in the interventricular septum (IVS). Such finding was confirmed at histology, in absence of inflammatory infiltrate. No congenital cardiac abnormalities were observed, coronary arteries and cardiac valves were free from disease (heart weight=400 g; LV anterior and posterior wall, RV and IVS thicknesses=1.1, 0.3, 0.5 and 1.5 cm); perivisceral congestion, brain and lung oedema were noted, whereas toxicology was unremarkable.

Genetic analysis was carried out on the exonic regions and splice junctions of 128 genes associated with a wide range of arrhythmias and cardiomyopathies (Extend Cardio Solutions, SOPHiA GENETICS), a heterozygous pathogenic truncating variant in Filamin C (FLCN; NM_001458.5:c.7251+1G>A) was detected and confirmed through Sanger sequencing.

In light of this, the cause of the death was attributed to a fatal arrhythmia triggered by an ALVC.

The victim's family underwent clinical screening: the father of the
victim had non-specific depolarisation abnormalities on ECG but refused to undergo further tests, including a cascade genetic screening.

The children of the victim showed normal ECG and echocardiogram, but their mother chose not to proceed with the genetic screening.

**Conclusion**. In ACM, fibro-fatty replacement of the myocardium originates on the subepicardial side of the ventricular wall, followed by endocardial progression and inflammatory infiltrates. Extensive monoventricular, biventricular and ICS involvements can

be seen in advanced stages of the disease, which are clinically characterized by symptoms of (bi)ventricular dysfunction, whereas SD tends to be the only clinical manifestation in the early stages of the disease.
FLNC mutations play a relevant role in cardiomyopathies, with a prominent role in dilated cardiomyopathy and hypertrophic cardiomyopathy always associated to malignant clinical course and a high risk of SD.
The proband carried a G>A transition removing the splice donor site for intron 43 in the FLNC gene, leading to a premature truncation of the protein, 21 amino acids downstream of the mutation site, with haploinsufficiency of FLNC.
The filamin C protein is primarily expressed in striated muscle, where it interacts with the dystrophin-associated-glycoprotein complex, integrin, and Z-disc protein. Reduced levels of filamin C protein hamper mechanical force transduction at intercalated disks and costameres by weakening the binding of the Z-disk to the plasmatic membrane. This kind of impairment in a tissue naturally subjected to high mechanical force generation, leads to fibrotic replacement, dilation and systolic dysfunction, especially confined in the left ventricle.
To date, this is the first report assessing the post-mortem detection of a FLNC truncating mutation.
From a medico-legal perspective, family and victim's own history, and the victim's own medical history gave no indications of possible problems.
Moreover, the morphological aspect of the heart was not suggestive of an early stage, making it likely that the subject either did not undergo clinical examinations or that any cardiac symptoms were overlooked.
The absence of medical documentation or symptoms made it possible to exclude any medical liability.

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## Forensic autopsy databases in different countries

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**Introduction**. In July 2025, a review article titled Forensic Pathology was published in the New England Journal of Medicine[1]. The paper provides an overview of forensic pathology in the United States. Although its framework cannot be directly applied to countries with different systems and contexts, it includes a table summarizing the scope of forensic pathology[1]. This table lists roles that forensic pathology plays, such as contributing to public health, responding to infectious diseases and disasters, and advancing research on human diseases.
In Japan, the main institutions responsible for practical forensic autopsies are university departments of forensic medicine. Most autopsies are conducted at the request of prefectural police authorities. For each case, information such as the cause and estimated time of death is provided in the form of death certificates or expert reports. However, these data remain confined to individual cases, and there is no national system for aggregating or analyzing them on a larger scale.
**Materials and methods**. This study investigated and compared the current status of forensic autopsy databases in Japan and especially at Kyushu University, Osaka Medical and Pharmaceutical University, Saga University and Wakayama Medical University.
**Results**. Some institutions did not compile data on autopsies, while others entered information into FileMaker.
**Conclusion**. In Japan, there is currently no well-established national database for forensic autopsies, and the disclosure of information related to judicial autopsies is restricted by legal constraints. In contrast, other countries have developed integrated national databases and specialized databases tailored to specific purposes, which are utilized for research, public health, and policy development. Moving forward, it is strongly desired that Japan also promote the development of a national-level database for forensic medicine, overcoming ethical and legal challenges in order to return forensic information to society.

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## Forensic discrimination of death mechanisms in disaster settings: a comparative autopsy study

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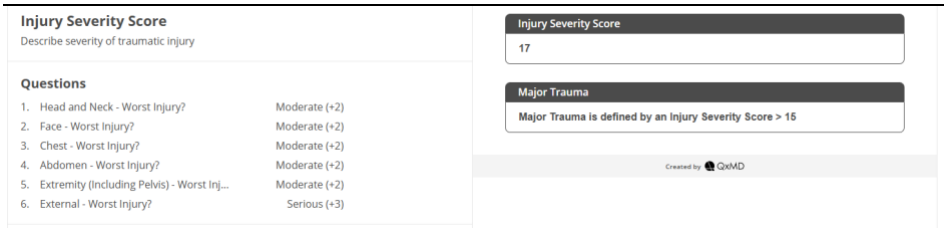
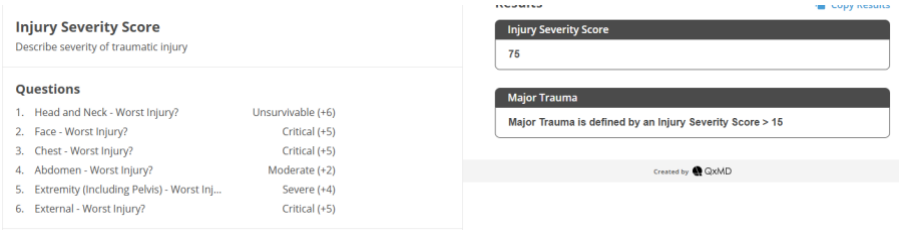
**Introduction**. The present contribution aims to highlight the decisive role of autopsy, integrated with histopathological examination, in determining the cause and mechanism of death in two individuals recovered from beneath the debris of a collapsed dwelling following a landslide. The bodies, retrieved the day after the catastrophic event, were located approximately ten meters apart and, based on circumstantial data and findings collected during the scene investigation, were likely in close proximity at the time of the building's collapse. Despite the shared environmental and temporal context, the autopsy findings revealed significant discrepancies in both macroscopic and microscopic features, supporting different pathogenetic mechanisms of death. The objective of this study is therefore to demonstrate how, even in disaster settings that appear causally uniform, a thorough medico-legal investigation allows accurate discrimination of the determinism of death.
**Materials and Methods**. Judicial scene investigation reports and postmortem inspection records relating to the two subjects were analyzed. In the first case, concerning a 32-year-old male, the external examination was performed at the site of recovery; in the second case, involving an 84-year-old female, the external examination was conducted in the autopsy room of the municipal mortuary due to environmental safety concerns. Both bodies subsequently underwent judicial autopsy performed according to the anatomical layer-by-layer technique, with organ removal following the Virchow (one-by-one) method. Tissue samples were collected for histological analysis.All traumatic injuries identified at the autopsy table were classified and analyzed using the New Injury Severity Score (NISS), which is employed to describe injury severity in trauma patients. Major trauma is defined by a score > 15. Injury severity in each of the six body regions is evaluated according to the Abbreviated Injury Scale (AIS). The three injuries with the highest AIS scores are used to calculate the NISS; each of these scores is squared and the results are summed. The score ranges from 3 to 75. If any injury is classified as unsurvivable (AIS = 6), the total score is automatically assigned a value of 75 [1, 2].
**Results**. In the male subject, the external examination and autopsy documented a traumatic injury pattern that was overall less severe than in the second case, albeit associated with marked asphyxial signs. Specifically, there was imbibition of the facial soft tissues, extensive hemorrhagic injection of the bulbar and tarsal conjunctivae with bilateral chemosis, and hemorrhagic imbibition of the labial tissues with petechial hemorrhages. Twelve rib fractures were identified, along with cerebral vascular congestion and diffuse subpleural emphysema with pulmonary congestion. Histological examination was consistent with autopsy findings and demonstrated acute pulmonary emphysema, acute pulmonary edema, subpleural and intra-alveolar hemorrhages, and mild fat embolism, grade I according to Falzi's classification. Overall, the findings supported a mechanism of mechanical asphyxia secondary to burial under debris, with ventilatory compromise and failure of the respiratory bellows mechanism in a subject who was alive at the time of the collapse. The NISS score was 17, indicative of major trauma, though not sufficient in itself to account for death.




In the female subject, conversely, severe traumatic-mechanical injuries predominated. A large right temporo-parieto-occipital hematoma involving the temporal muscle was observed, associated with a discontinuity between the atlas (C1) and the occipital bone, as well as significant hemorrhage from the spinal canal. A fracture of the C7 vertebral body with spondylolisthesis over T1 was present, along with fractures of the clavicle and sternal body and twenty-three rib fractures. The lungs showed chronic emphysema, without the typical features of acute asphyxia observed in the first subject. The constellation of injuries, particularly the cranio-cervical lesions involving the upper cervical spine with evidence of spinal cord injury, was in itself sufficient to account for rapid death due to severe cranio-encephalic and spinal trauma. The NISS score was 75, as the cervical spine injury was classified as unsurvivable.




**Conclusions**. Comparative analysis of these two cases demonstrates that, within the same catastrophic event and in subjects recovered in close spatial and temporal proximity, the mechanism of death may differ substantially. In the first subject, the findings are consistent with violent mechanical asphyxia due to burial, with temporary survival following the collapse and subsequent progressive respiratory compromise in a polytraumatized individual whose traumatic injuries were less severe than those observed in the second subject. In the latter, the severity and distribution of traumatic lesions, particularly involving the cranio-cervical region, indicate a direct traumatic mechanism of death, likely of rapid onset, with a lesser contribution from asphyxial factors.

This case underscores the indispensable value of comprehensive judicial autopsy and integrated histological examination in reconstructing the medico-legal dynamics of death, even in apparently homogeneous environmental contexts. In disaster scenarios, a systematic and multidisciplinary approach is essential not only to ascertain the cause of death, but also to define its mechanism and timing, with significant legal, insurance, and epidemiological implications.

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## Forensic investigations on a pre-skeletonized body: the importance of multidisciplinarity in forensic pathology

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**Introduction**. In May 2025, an unidentified body was found in a wooded area in Puglia. The corpse was in an advanced state of decomposition, partially skeletonized and diffusely colonized by larvae and pupae of cadaveric diptera. Police investigations linked the body to a woman who had disappeared one month earlier in the same area. The judicial authorities requested an autopsy to determine the cause, means and time of death, along with all the necessary investigations for personal identification.

**Materials and methods**. For personal identification, forensic odontology investigations were performed. The ante-mortem x-ray orthopantomograms of the disappeared woman were compared to the post-mortem x-ray orthopantomograms, as well as the ante-mortem and post-mortem dental formulas [1].

To estimate the PMI, several larvae samples were collected from the body. Subsequently, they were treated first in boiling water and then in ethyl alcohol, before being examined under an epimicroscope. For the estimation of PMI, we also found puparia on the body and clothes, some closed but some other open and empty [2].

An animal bitemark was identified on the right thigh, which was excised and fixed in formalin for subsequent investigations. A comparison was then conducted between the animal bitemark and several dental casts of various species —differing in width, size and shape—available at the Institute of Legal Medicine of Policlinico of Bari, to assess the presence of traumatic lesions due to others.

Given the suspicion that the cause of death was drug-related, a toxicological investigation was conducted to search drugs the woman was known to be taking for depression (sertraline, triazolam, flurazepam and quetiapine). A broad toxicological investigation was therefore conducted on multiple available matrices: urine collected from a renal cyst found on the right kidney, ileo-psoas muscle, liver, hair and larvae collected from the body [3]. The analyses were performed by liquid chromatography-high-resolution tandem mass spectrometry (LC-HRMS/MS).

**Results**. The presence of preserved genital soft tissue confirmed that the body belonged to a female sex.

The comparison between ante-mortem and post-mortem x-rays OPTs and ante-mortem and post-mortem dental formulas showed a perfect match, confirming that they belonged to the same person.

At the epimicroscope analysis, the characteristics of the rostrum and the respiratory spiracles of larvae are suggestive of specimens belonging to the Calliphoridae family, genus Calliphora, in their third stage of development (III Instar). This finding, taken together with the presence

of open puparia on the body and the state of withering of the body, allowed us to estimate a PMI about 30-35 days.
The autopsy revealed the absence of traumatic injuries due to others, except for the animal bitemark, a sign of post-mortem action of macrofauna. The morpho-dimensional comparison of the bitemark with the dental casts demonstrated compatibility with the dentition of a medium-sized canid. This finding is consistent with the circumstantial evidence, given that the cadaver was found in a wooded area in Puglia.
Considering that the body was pre-skeletonized, with internal organs almost decomposed except for the kidneys, the presence of a renal cyst on the right kidney containing a considerable volume of urine represented an exceptional autoptic finding. At the toxicological investigations, the detection of drugs and their metabolites in urine preserved in the renal cyst supported recent intake, while hair analysis confirmed chronic drug use. Findings from larvae, muscle and liver further corroborated systemic exposure.
The toxicological findings were consistent with a fatal acute poly-drug intoxication (in a background of chronic use confirmed by hair findings) and, taken together with all other findings, supported the classification of the death as suicide.
**Conclusion**. This case report highlights the indispensable nature of multidisciplinary collaboration in contemporary forensic science. The resolution of complex investigations rarely hinges on a single discipline; rather, it emerges from the integration of different expertise. This synergistic framework not only enhances the accuracy of findings but also ensures that the final judicial conclusions are supported by a comprehensive, 360-degree scientific perspective.

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## Hesitation marks or something else? The importance of an inter-culturally approach in forensic pathology

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**Introduction.** Forensic medicine is traditionally grounded in methodological rigor and evidence-based reasoning. The forensic pathologist is trained to interpret the body through morphology, biomechanics and toxicology, weighing each element according to scientific reliability. This "vertical" culture (deep, technical, and highly specialized) represents the indispensable foundation of medico-legal work. However, contemporary forensic practice increasingly unfolds within multicultural and migratory contexts, where the body is not only a biological structure but also a bearer of cultural, religious, and social meanings. The medico-legal expert must also cultivate a broader, transversal, "horizontal" competence capable of integrating anthropological, geographical, and socio-cultural knowledge into the interpretative process. The present case exemplifies how even apparently simple cutaneous findings may require a culturally oriented approach in order to avoid interpretative bias.
**Case Presentation.** A 40-year-old Moroccan man presented to the emergency department of a sicilian hospital (Southern Italy) due to acute opioid intoxication. The emergency physicians requested a medico-legal consultation. The inspection revealed multiple inveterate, linear, ribbon-like scars arranged in parallel or sub-parallel distribution. The lesions were located on the anterior abdominal wall, the right hemithorax, and both volar forearms. They appeared superficial, pale, homogeneous in width within anatomical clusters, and well healed. No signs of recent trauma or defensive injuries were observed. The cicatricial lesions raised a relevant interpretative question.
**Discussion.** When confronted with multiple parallel linear scars in an opioid user, the immediate morphological association is with hesitation marks or repetitive non-suicidal self-injury. From a strictly technical perspective, the anatomical accessibility of the involved areas, the superficiality of the lesions, and their relative uniformity support compatibility with self-inflicted cutting. However, forensic reasoning cannot rely solely on morphological plausibility. The man's Moroccan origin introduces an additional interpretative dimension. Ritual scarification is documented in numerous societies worldwide and encompasses a wide range of anatomical locations, techniques, and symbolic meanings. In several sub-Saharan African communities, for instance, intentional skin incisions are performed duing initiation rites to mark the transition to adulthood, signal ethnic affiliation, or denote social status within the group. These scars are not random injuries but culturally codified bodily inscriptions, often executed in specific patterns and repeated under controlled ritual conditions. Their meaning is inseparable from the cosmological and social structure of the community. Again, one might be tempted to consider ritual self-inflicted injuries associated with Ashura commemorations. Yet such a conclusion, if drawn automatically from ethnic origin alone, would represent a cultural shortcut rather than a scientific deduction. The majority of Moroccan Muslims are Sunni, and ritual self-flagellation practices are not culturally prevalent in Morocco. Moreover, the topography of the lesions, involving abdomen and volar forearms rather than predominantly dorsal regions, does not correspond to the most frequently documented patterns of ritual flagellation injuries. Conversely, the distribution of the scars in anatomically

reachable areas strongly supports the feasibility of self-infliction. A further hypothesis concerns hetero-inflicted trauma during migratory routes, such as flogging or abuse. While this possibility must always be considered in vulnerable populations, the relative homogeneity, superficiality, and orderly clustering of the scars, together with the absence of additional traumatic stigmata, do not strongly support such a mechanism. The essential point of this case does not lie in definitively labeling the scars, but in highlighting the interpretative pathway. The forensic pathologist must first apply rigorous morphological analysis grounded in evidence. Subsequently, cultural and geographical context must be critically examined, not as a source of automatic explanations, but as a framework within which hypotheses are tested and, when necessary, discarded.

**Conclusion.** This case underscores that culturally oriented forensic practice does not weaken scientific rigor; rather, it refines it. The medico-legal expert must combine deep technical competence with interdisciplinary sensitivity and reflexive judgment. In multicultural contexts, scars may reflect psychopathology, ritual practice, social violence, or personal history. Only through the integration of vertical scientific expertise and transversal cultural awareness can forensic medicine avoid both reductionism and stereotyping, preserving methodological integrity and interpretative fairness.

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## Peri-operative death in major non-cardiac surgery: a forensic approach

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**Introduction**. More than 1% of patients aged ≥45 years undergoing major non-cardiac surgery (NCS) die within 30 days, with perioperative cardiac complications representing the leading cause of death. These events are frequently clinically silent due to the absence of symptoms, and fatalities may occur unexpectedly, often leading to allegations of malpractice. This study explores the complex scenario of forensic investigations of perioperative deaths after major NCS through a literature review and two illustrative cases.

**Materials and methods**.

**Case 1** A 79-year-old woman underwent C1–C2 arthrodesis. Preoperative evaluation showed normal ECG and chest X-ray, good functional capacity, and ASA II classification. Shortly after extubation, cardiac arrest occurred. Cardiopulmonary resuscitation was performed and the patient was transferred to ICU with GCS 3. During surgical revision for tracheotomy, a second fatal cardiac arrest occurred. Postmortem CT confirmed correct arthrodesis. Autopsy and histology revealed fatty infiltration of the right atrial wall and myocardial fiber undulation in the right ventricle and septum. Death was attributed to acute respiratory failure due to arrhythmogenic right atrial dysplasia.

**Case 2** A 63-year-old woman underwent shoulder arthroscopy in beach-chair position under general anesthesia. She had ASA II class with normal preoperative ECG, chest X-ray and laboratory tests. After surgery she failed to regain consciousness and was admitted to ICU with post-anoxic ischemic coma, dying shortly afterwards. Autopsy, conducted in collaboration with an anesthesiologist, identified hypoxic-ischemic brain injury related to inadequate cerebral perfusion during surgery as the cause of death.

**Results**. Perioperative myocardial injury is increasingly recognized as a major contributor to postoperative mortality. Several definitions - Major Adverse Cardiac Events (MACE), Perioperative Myocardial Infarction/Injury (PMI), and Myocardial Injury after Non-cardiac Surgery (MINS) - are often used interchangeably despite relevant differences. Recent guidelines (2022 ESC; 2024 AHA/ACC) emphasize biomarker-based diagnosis using cardiac troponins, even in the absence of symptoms, because of their prognostic value. However, troponin monitoring is currently recommended only in high-risk patients and optimal management remains uncertain. MACE is a composite endpoint mainly used for research and risk stratification and does not identify a specific pathological substrate, limiting its use in medico-legal causation analysis. PMI refers to myocardial damage detected by postoperative troponin elevation above the 99th percentile, including both ischemic and non-ischemic causes. MINS represents a subset of ischemic myocardial injury defined by postoperative troponin elevation without non-ischemic causes and is independently associated with increased mortality. These distinctions are crucial for evaluating standard of care, causal attribution and preventability.
Current cardiac risk calculators were primarily designed to predict MACE or overt myocardial infarction and may therefore underestimate the risk of PMI or MINS. Indeed, many events occur in patients classified as low or intermediate risk. Literature also reports discrepancies between clinical diagnoses and autopsy findings in up to 47% of cases. Histology remains essential but may be negative in very early myocardial injury. Postmortem biochemistry lacks standardized reference values. Therefore, preservation of premortem samples is important.

International recommendations also support the use of postmortem imaging and multidisciplinary collaboration.

**Conclusion**. Medico-legal experts must remain updated on evolving clinical guidelines and scientific evidence to ensure accurate evaluations. Autopsy retains a unique role not only in malpractice litigation but also as an important tool to improve perioperative risk assessment and clinical practice. Fatal perioperative events after major NCS require thorough multidisciplinary investigation to distinguish unavoidable complications from preventable adverse events of cardiac or non-cardiac origin.

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## Presumed death certification: medico-legal and bioethical reflections

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**Introduction**. Presumed death certification represents a legal instrument aimed at judicially ascertaining the death of a missing person in the absence of direct biological evidence. While primarily rooted in civil law, this declaration carries significant medico-legal and bioethical implications, particularly in contexts involving unresolved disappearances, mass disasters, or severely compromised human remains.
Recent legislative reforms in several jurisdictions, including Italy, have shortened the temporal thresholds for issuing presumed death declarations, thereby increasing the relevance of scientific identification methods and ethical scrutiny.
This contribution explores the medico-legal role of forensic sciences in supporting presumed death determinations and reflects on the associated bioethical dimensions, with particular attention to human identification and the rights of families.
**Materials and Methods**. A narrative review of national and international legal frameworks governing presumed death was conducted, alongside an analysis of forensic literature focusing on identification practices in missing persons cases and mass disaster scenarios.
Emphasis was placed on medico-legal disciplines most frequently involved in such contexts, including forensic pathology, forensic genetics, forensic anthropology, and forensic odontology.
Ethical considerations were examined with reference to human dignity, fundamental rights of the deceased, proportionality of investigative procedures, and the psychosocial impact on relatives.
**Results**. The analysis highlights that presumed death certification is intrinsically characterized by a condition of evidentiary uncertainty, which distinguishes it from biologically certified death and renders it potentially reversible.
Forensic sciences play a crucial role in reducing this uncertainty by enabling post-mortem identification even in the absence of intact bodies, particularly through DNA and dental data comparisons. Among the available methodologies, forensic odontology emerges as a reliable, cost-effective, and underutilized tool, especially in scenarios involving thermal damage or advanced decomposition.
From an ethical standpoint, the premature issuance of presumed death certification without exhaustive forensic investigation risks undermining principles of justice, proportionality, and respect for persons, whereas robust identification protocols contribute to legal certainty and humane treatment of families.
**Conclusion**. Presumed death certification lies at the intersection of law, forensic science, and bioethics. Its legitimacy and social acceptability depend not solely on temporal legal criteria but also on the rigorous application of available medico-legal identification methods. Strengthening the integration of forensic disciplines - particularly forensic odontology - within standardized investigative protocols can substantially mitigate uncertainty and ethical tension, serving both the administration of justice and the fundamental human need for truth and closure.


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## Septic shock from stec or heat stroke? Sudden death in a forest ranger during wildfire suppression. Differential diagnosis and medico-legal implications

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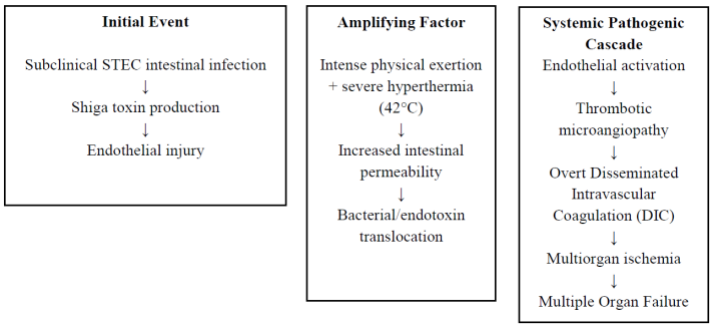
**Introduction**. Sudden collapse occurring during occupational activity under conditions of severe thermal stress requires a careful differential diagnosis between Exertional Heat Stroke (EHS), fulminant septic shock, primary Disseminated Intravascular Coagulation (DIC), and multifactorial pathogenic mechanisms.
In forensic pathology, the correct distinction among these conditions is essential for reconstructing the causal sequence and for the medico-legal qualification of the event.
**Case Report**. A 28-year-old forest ranger with no relevant past medical history had consumed shellfish in the days preceding the event. During wildfire suppression activities, he separated from the work team and was later found unconscious with gasping respiration. Emergency medical personnel documented body temperature of 42°C and Glasgow Coma Scale score of 3. The patient was transported by helicopter emergency service to ARNAS G. Brotzu Hospital (Cagliari). Clinical investigations revealed anuria, overt Disseminated Intravascular Coagulation (DIC), thromboelastography showing absence of coagulation activity, and positivity for Shiga toxin-producing Escherichia coli (STEC).
**Clinical Course**. Hemolytic-uremic syndrome (HUS) rapidly developed, followed by Multiple Organ Failure (MOF). Death occurred approximately 24 hours after hospital admission.




**Autopsy Findings**. External examination revealed multiple petechial lesions diffusely distributed in the supraclavicular region and over the thoracic surface. In addition, two thermal burn injuries were documented: one located on the right thigh, characterized by a central necrotic area measuring approximately 4 × 4 cm, and another on the right arm, with a necrotic area measuring approximately 2 × 1.5 cm. At internal examination, the lungs showed acute pulmonary edema associated with centrilobular emphysema and recent intra-alveolar hemorrhages containing numerous siderophages. The kidneys exhibited cortical necrosis with thrombotic microangiopathy, while the gastrointestinal tract revealed acute hemorrhagic enterocolitis. An extensive retroperitoneal hemorrhage was also documented. Overall, the findings were consistent with a systemic coagulopathic process indicative of Disseminated Intravascular Coagulation (DIC).

**Forensic Interpretation**. The anatomo-pathological pattern is consistent with fulminant septic shock due to STEC infection, complicated by hemolytic-uremic syndrome and disseminated intravascular coagulation. According to current scientific evidence, hyperthermia likely acted as a contributory and amplifying factor rather than the primary cause.

**Conclusions**. The multidisciplinary integration of clinical, pathological, and forensic findings allowed reconstruction of the pathogenic cascade responsible for death. Intense physical exertion and extreme thermal stress (42°C) did not merely represent an incidental circumstance but acted as a causally relevant trigger, promoting increased intestinal permeability and endotoxin translocation. Consequently, an STEC infection—potentially manageable under normal conditions—rapidly evolved into a fulminant systemic disease characterized by Disseminated Intravascular Coagulation and Multiple Organ Failure. A direct and determinant causal relationship can therefore be identified between occupational activity under extreme environmental conditions and the fatal outcome, supporting the classification of the event as a work-related accident.

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## "Skeletons in the closet": the relevance of forensic autopsy in the investigation of the "living with the dead" phenomenon – a case series from Northern Italy

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**Introduction**. The living with the dead phenomenon refers to situations in which an individual continues to share the same domestic environment with a deceased person for a prolonged period before the death is reported. While in some cases this behaviour may be associated with criminal concealment, it may also arise from social isolation, psychiatric conditions or dysfunctional interpersonal dynamics [1, 2]. In light of the relevant legal and social implications, forensic investigation, particularly forensic autopsy, plays a crucial role in excluding violent death and reconstructing the circumstances surrounding the event, despite being significantly hindered by the advanced state of decomposition typically encountered in these cases [3].

**Materials and methods**. A retrospective study was conducted on forensic autopsies performed at the Unit of Legal Medicine of the University of Pavia and Padua between 2020 and March 2026. Cases were included when the deceased was discovered inside a domestic environment in an advanced state of decomposition while one or more cohabitants were still living in the same residence. For each case we analysed demographic data, the relationship between the deceased and the cohabiting individual, estimated duration of post-mortem cohabitation, circumstances of body discovery, and the forensic investigations performed. The diagnostic workflow included scene investigation when requested by judicial authorities, full forensic autopsy, and additional examinations such as post-mortem radiology, histology, toxicology and anthropological analysis when applicable.

**Results**. Five cases of living with the dead were identified. The deceased included both males (N = 2) and females (N = 3), involving middle-aged and elderly individuals (mean age = 62 years; range = 40-91 years). All bodies were discovered within domestic environments, most frequently in bedrooms. The estimated period of cohabitation with the corpse ranged widely, from approximately two weeks to more than two years. Correspondingly, different post-mortem transformation processes were observed, including putrefaction (emphysematous-colliquative stage), corification, mummification and advanced skeletonization. A complete forensic autopsy was performed in all cases. Despite the advanced decomposition, autopsy allowed assessment of potential traumatic injuries such as bruises and pressure lesions; in one specific case, a hanging mark and fractures of the superior corns of the thyroid cartilage were detected, supported by post-mortem imaging (PMCT and micro-CT). Ultimately, no findings suggestive of homicidal violence were identified in any of the cases; even the hanging was classified as a suicide. Histological examinations supported the macroscopic findings and frequently revealed pathological conditions potentially sufficient to explain death, such as severe atherosclerosis or myocardial fibrosis, and demonstrated the vitality of the hanging signs. In the skeletonized case, forensic anthropological analysis identified signs of previous osteosynthesis that also contributed to personal identification. Toxicological analyses were performed when feasible and showed only low concentrations of ethanol compatible with post-mortem production; in one case acetone was detected, suggesting possible metabolic

imbalance prior to death. Overall, the combined forensic investigations allowed the exclusion of third-party involvement in all cases: one death was classified as a suicide by hanging, while the remaining four were attributed to natural causes. Furthermore, collateral investigations highlighted diverse psychosocial motivations for the corpse concealment: cognitive impairment (early-stage dementia) of the cohabitant, shame regarding the severe domestic squalor combined with the fear of judicial investigation, intra-familial coercion, emotional detachment resulting from a highly conflictual and violent relationship, and psychiatric distress in an elderly widower who was unable to process the sudden loss of his daughter.

**Conclusion**. The living with the dead phenomenon represents a rare and poorly documented condition in forensic literature. In such cases, advanced decomposition and unusual discovery circumstances may raise suspicion of concealed homicide. Our experience highlights the central role of forensic autopsy and ancillary examinations in excluding criminal involvement, identifying pathological causes of death and providing a scientific basis for the subsequent interpretation of the psychosocial dynamics underlying the prolonged coexistence with the deceased.

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## Toward best practices for DNA samples collection and preservation in the autopsy room

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**Introduction**. In the era of DNA profiling technology, small quantities of trace material (i.e., non-visible staining) can be typed to obtain results also from the DNA that is subject to easy and ubiquitous modes of transfer. Actually, there is now a shift from the question "whose DNA is this?" to the question "how did it get there?" [1].
In the context of forensic pathology, the higher sensibility of DNA analysis in forensic genetics brings out the contamination issue of samples collected in autopsy room. As previously reported with few scientific contributions, there is the risk of contamination by exogenous DNA for samples collected from clothes or body surfaces of the victim in the mortuary, even if autopsy surfaces and instruments might appear falsely "clean". The aim of the present study was to review the existing literature on contamination of post mortem facilities and to stimulate a multidisciplinary approach involving experts in forensic pathology and genetics for the development of good practices for samples collection in autopsy room.
**Materials and methods**. Literature review was conducted in January 2026 on three electronic databases (Pubmed, Web of Science, Scopus) using "DNA", "contamination" and "postmortem facilities" or "autopsy room" or "mortuary"as search terms. It was exctracted from the articles: year of publication, authors and their affiliation, swabbed or sampled surfaces and items, DNA quantification and profiling.
**Results**. Five articles on this topic were retrieved, published between 1997 and 2022. The analyzed studies consistently demonstrate a high prevalence of human DNA contamination in in postmortem facilities, even after routine cleaning procedures. Quantifiable human DNA was detected in autopsy room at variable rates across studies (38.3%-73.6%), reflecting ongoing advances in genetic analysis methods. DNA was identified on sampled surfaces, particularly countertops and autopsy tables, as well as on instruments such as scissors and measuring scales, with concentrations ranging from undetectable to 12.4 ng/µL. Amplified DNA predominantly yielded mixed profiles, reaching up to 83.6% in a 2022 study. Potential sources of contamination also included the deceased, pathologists, and mortuary staff. Procedures to prevent contamination, including decontamination and sterilization protocols as well as the use of disposable instruments, were also discussed.
**Conclusion**. The improvements in DNA analysis lead to the detection of small amounts of transferred DNA unrelated to the crime, such as background DNA deposited by activities prior to the crime or other DNA introduced through secondary DNA transfer as in autopsy room. This transferred DNA would complicate the interpretation of STR profiles showing mixed profiles or unknown single source profile not related to the crime. The DNA transfer at postmortem facilities is not a new issue, but the "mobility" of DNA must be considered in Court and as subject of research, as underlined by publications showing that DNA might be distributed even in the context of cleaning scenarios [2]. The autopsy room should be considered a potentially contaminated environment, similar to a crime scene or a transport vehicle, suggesting the need to adopt dedicated strategies for trace DNA collection in the autopsy setting. Nevertheless, the environmental decontamination strategies adopted during the COVID- 19 pandemic only partially solved the long- standing issue of DNA contamination

of postmortem examination facilities [3]. Considering the high sensitivity of forensic genetic analyses and the awareness of the occurrence and consequences of DNA transfer events, the development of an effective protocol for collecting samples in autopsy room requires the involvement of a cross-disciplinary forensic science team. While there are guidelines within forensic science that make reference to collect samples in sexual assault cases, these focus primarily on the activity of health operators in emergency department; none provide specific guidance on decontamination protocol of postmortem facilities, preservation of victim's clothes, biological samples collection, and preservation in autopsy room. In addition, best practices could prevent any loss of DNA eventually precluding the identification of a person of interest, As such, laboratories, judges, and law enforcement would benefit from procedures guiding the collection of each evidence item in autopsy room to reduce the risks of DNA loss or secondary DNA transfer leading to an inaccurate source attribution.

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## Unconventional weapon: the role of forensic radiology in the investigation of a suicide with a homemade firearm

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**Introduction**. A "handcrafted firearm" is a crudely manufactured device that preserves the essential functional characteristics of a conventional firearm. The rare cases reported in literature involving such weapons are prevalently suicides. Homemade firearms are found most often in countries and communities where they provide an inexpensive and accessible alternative to more rigorously controlled commercial firearms. For example, in the USA, because firearms are relatively easy to acquire, homemade guns have become quite obsolete. Most improvised firearms share similar structural features, typically consisting of steel or iron tubes adapted to function as barrels and rudimentary firing mechanism. From a forensic perspective, injuries caused by handcrafted firearms may present interpretative challenges, as conventional wound ballistic principles are not always fully applicable due to the atypical construction and unpredictable ballistic behaviour. We report a case of suicide involving a four-barrelled homemade firearm, notably characterized by on-site radiological analysis of the weapon at the death scene.
**Material and methods**. The case was analyzed through a death scene investigation, during which an on-site X-ray of the weapon was performed and the firearm was disassembled. A post-mortem CT scan (PMCT) was performed, followed by a complete forensic autopsy with histological analysis.
**Results**. The death scene investigation revealed that the body was lying supine on the floor in the entrance room, alongside a bed. A small table in front of him, slightly moved by first responders, held a homemade four-barreled shotgun. Bloodstains and scattered shot pellets were present on the bed. Inspection of the weapon showed that the four barrels were welded together side by side, each designed to accommodate 12 mm hunting cartridges. The system incorporated four spring-loaded percussion mechanisms activated by locking spring-loaded metal levers.
Two intact cartridges were observed on the X-ray; after disassembling the firearm, two spent cartridge cases were also found.
Examination of the body revealed an irregular 6 × 4 cm wound in the right anterior thorax, exposing the thoracic cavity.
The PMCT scan of the body and the autopsy revealed a single open chest wound in the right hemithorax, along with perforating injuries involving the right lung, diaphragm and liver. Several metallic pellets were detected within the thoracic and abdominal cavities and a right-sided pneumothorax was observed.
During dissection, some plastic fragments consistent with a shotgun wad were identified near the liver. These findings allowed the identification of an anatomical trajectory with cranio-caudal, antero-posterior and right-to-left orientation. Histological examination supported the determination of the cause of death as acute cardiopulmonary failure due to cardiogenic-haemorrhagic shock, secondary to massive intrathoracic haemorrhage and right pneumothorax resulting from a gunshot wound inflicted by a multiple-projectile discharge.

**Conclusion**. This case illustrated that even rudimentary handcrafted firearms can produce fatal injuries comparable to those caused by conventional shotguns. The integration of radiological, autopsy, histological and ballistic findings is crucial in such cases to accurately reconstruct wound dynamics. From a forensic perspective, this case underscores the critical importance of radiological assessment performed directly at the death scene when improvised firearms are involved. Handcrafted multi-barrel device may contain undischarged cartridges and unstable firing mechanisms, posing a significant risk of accidental discharge during manipulation. This approach highlights the expanding role of applied radiology beyond diagnostic post-mortem investigation, extending to real-time scene safety management. The integration of radiological tools into death scene protocols may therefore represent an important advancement in mitigating occupational risk when dealing with unconventional or improvised ballistic devices.