

CASE REPORT**PATHOLOGY/BIOLOGY**

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Histological Diagnosis of Myocardial Sarcoidosis in a Fatal Fall from a Height

ABSTRACT: The major issues of medico-legal relevance in fatal falls from a height are the manner of death and the reconstruction of the event. We present a peculiar case of a fatal fall from a height of about 9 m, involving a 27-year-old woman. At the death scene investigation, no suicide notes, housebreaking marks, or signs of fight were found, thus weakening both the suicide and homicide hypotheses. Combining circumstantial, autopsy and toxicology data, the kinematic analysis of the jump/fall, and the histological evidence of a myocardial sarcoidosis involving the left ventricle, we hypothesized that the young woman might have accidentally fallen from the window because of a sudden loss of consciousness related to cardiac disease undiagnosed during life. We believe that our brief report is a good example of the powerful additional information that histological investigations can offer for reconstructing the dynamics of the event in falls from a height and other traumatic fatalities.

KEYWORDS: forensic science, falls from a height, death scene investigation, histology, myocardial sarcoidosis, reconstruction of the event

Falls from a height are mostly an urban phenomenon and represent a significant form of blunt trauma (1). In the absence of witnesses, it is usually very difficult to determine whether it was the consequence of an accident, suicide, or homicide (2). Many studies have dealt with the methodology of investigation to be utilized in such cases, proposing different strategies to address this relevant forensic issue. The kinematics of the jumping/falling pattern (3,4), the toxicological ascertainment (5), and the importance of carefully analyzing the location and pathological features of the victim's injuries (6–8) have been extensively stressed in the forensic literature.

In our brief report, we present a peculiar case of fatal fall from a height involving a 27-year-old woman affected by cardiac sarcoidosis and discuss the advantages and limitations of a thorough histopathological examination for the reconstruction of the event.

Case Report

A Sunday evening, in a peripheral area of Padova (Italy), a man called the emergency number “118” asking for medical assistance in place because he found an unconscious woman lying in the courtyard. When the rescue team arrived, the victim, a 27-year-old Tunisian woman, was already dead. The neighbor who advised the police told that while dining in his flat, he heard a sudden thud coming from the outside and, looking out the window, noticed the body of the woman. He underlined that he did not hear any scream.

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Death Scene Investigation

The corpse was found in a pool of blood at a distance of 3 m from the outer wall of the building, presenting impact injuries to the head and arms. A bloodstained rubble heap was present between the cadaver and the wall, at a distance of 1.5 m from the outer wall of the building.

The victim lived alone in a flat located on the third story. A thorough inspection of the apartment did not reveal any suicide notes, housebreaking marks, or signs of fight. The window, looking into the courtyard, was open and undamaged (size and height from the floor depicted in Fig. 1A).

Victim's Clinical and Personal Data

Interviews with the victim's general practitioner and friends revealed that she was not affected by any mental or physical disorders, that she was living a regular professional and private life, and that she had never attempted suicide before.

Autopsy and Histology Findings

Forensic autopsy was performed the day after the death. At external examination, the body (height = 1.68 m, weight = 63 kg) exhibited a laceration of the scalp on the left parieto-occipital region and two large hematomas on the extensor region of the forearms.

The cadaveric dissection revealed a large fracture originating from the left parietal bone and extending across the right parietal and occipital bones into the posterior cranial fossa of the right side, extensive subarachnoid hemorrhage and closely aggregated petechiae in the apices of the superficial cortex, multiple rib fractures, rupture of the liver and of the spleen, and bilateral fractures of the ulna and radius. Histology showed fresh blood in the subarachnoid

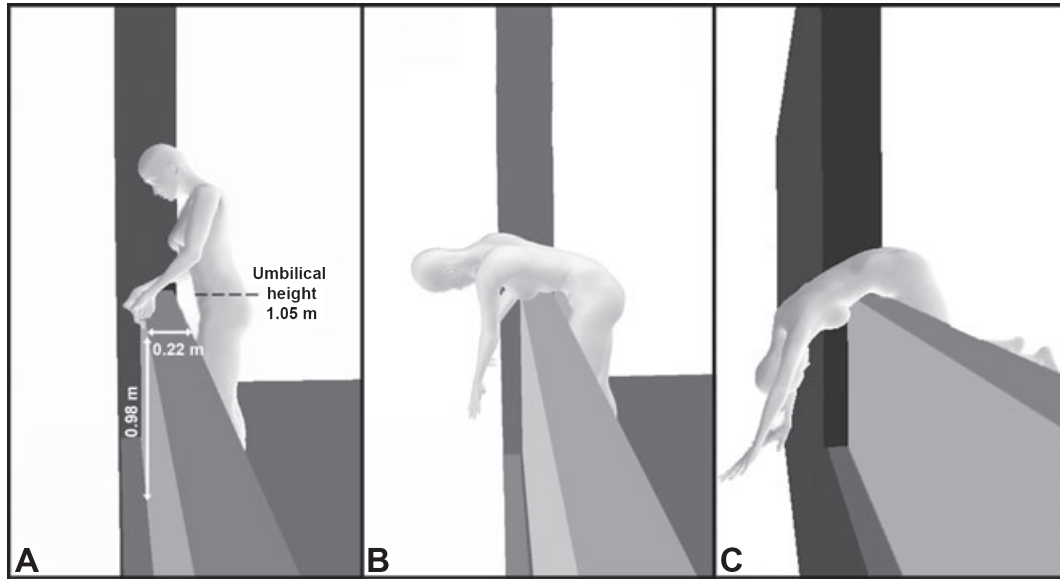


FIG. 1—(A) Sketch of the window depicting its height and width. Height of the center of gravity of the woman measured at the umbilicus (1.05 m). (B–C) Hypothetical reconstruction of the accidental fall of the victim.

space with underlying contusions of the cortex and several liver and spleen vital tears with hemorrhagic infiltration.

Multiple noncaseating granulomas composed of epithelioid cells, inflammatory cells, and occasional multinucleate giant cells were also found in mediastinal lymph nodes (Fig. 2A), lungs (Fig. 2B), spleen and heart (interventricular septum and left ventricular wall) (Fig. 2C–E). In several myocardial sections, small collections of lymphocytes without other cellular components were evident. An immunohistochemical investigation of the granulomatous lesions using the markers CD45 (leukocyte common antigen), CD68 (monocytes and macrophages), CD3 (T cells), and CD20 (B cells) revealed that the predominant component of the inflammatory cells was B lymphocytes and macrophages (Fig. 2F).

Toxicological screenings on blood and urine for alcohol, drugs of abuse (including psychedelic drugs), and psychoactive substances using gas- and liquid-chromatography mass-spectrometry techniques tested negative.

The cause of death was diffuse brain damage because of a fall from height. The young victim was found to be affected by a systemic sarcoidosis with myocardial involvement.

Discussion

Fatal descents from a height are of high forensic relevance, because at the time the body is found the manner of death can often be unclear. It is extremely important in these cases to take into account not only the autopsy findings but also toxicology results, circumstantial details and the medical, psychiatric, and social history of the victim.

In the reported case, the evaluation of all available data pointed toward an accidental fall as the most probable dynamic of the event.

In particular, the interviews with the deceased's medical practitioner and friends excluding any mental disorders or socioeconomic problems along with the lack of suicide notes weakened the suicide hypothesis.

On the other hand, because of the absence of any constricting wounds and/or signs of fight in the flat, the homicide hypothesis also appeared improbable.

The distance of the body from the site of descent was within the range reported for accidental falls (3). In fact, the point of impact was identified on a rubble heap at a distance of 1.5 m from the outer wall of the building (presence of blood stains), with the level of the height located on the third floor at about 9 m from the ground. For similar heights, Wischhusen et al. (4) have demonstrated that in passive falls (accidental), the distance from the level of the height is usually between 1 and 6 m, whereas in active jumps (suicide or homicide) it is likely to be >4 m.

Additionally, the window had no barriers and its height (0.98 m) was lower than the center of gravity of the woman (1.05 m at the level of the umbilicus) (Fig. 1A), thus failing to properly protect her from a fall (9).

Nevertheless, despite such evidence and in consideration of the finding that the victim was not under the influence of alcohol or drugs (5,7,10), the question why she might have fallen accidentally still remained open.

Histological examination revealed systemic sarcoidosis with multiple noncaseating granulomas located in the left ventricular wall and interventricular septum.

Sarcoidosis is a multisystemic disorder with an unknown etiology, characterized by noncaseating granulomas formed of pale-pink epithelioid cells, multinucleate giant cells, and a scanty rim of lymphocytes (11).

In cardiac sarcoidosis, the granulomas can be either extensive and confluent or microscopic and diffuse (12). In both cases, the myocardial conduction system is particularly vulnerable to the sarcoid granulomas (13,14). A complete heart block is the most common clinical onset in young patients (12), and many authors have reported cases of sudden death because of the myocardial involvement (15,16). Milder degrees of conducting disturbances, including first-degree heart blocks and various types of intraventricular conduction defects, which could initially be silent but can progress to a symptomatic complete heart block with syncopal episodes, have also been described (12). About 35% of patients remain asymptomatic, and 20–25% of all cases become evident for the first time at postmortem examination after sudden death (17).

Based on these assumptions, in spite of an entirely asymptomatic clinical history, the identification of myocardial fibrosis and several

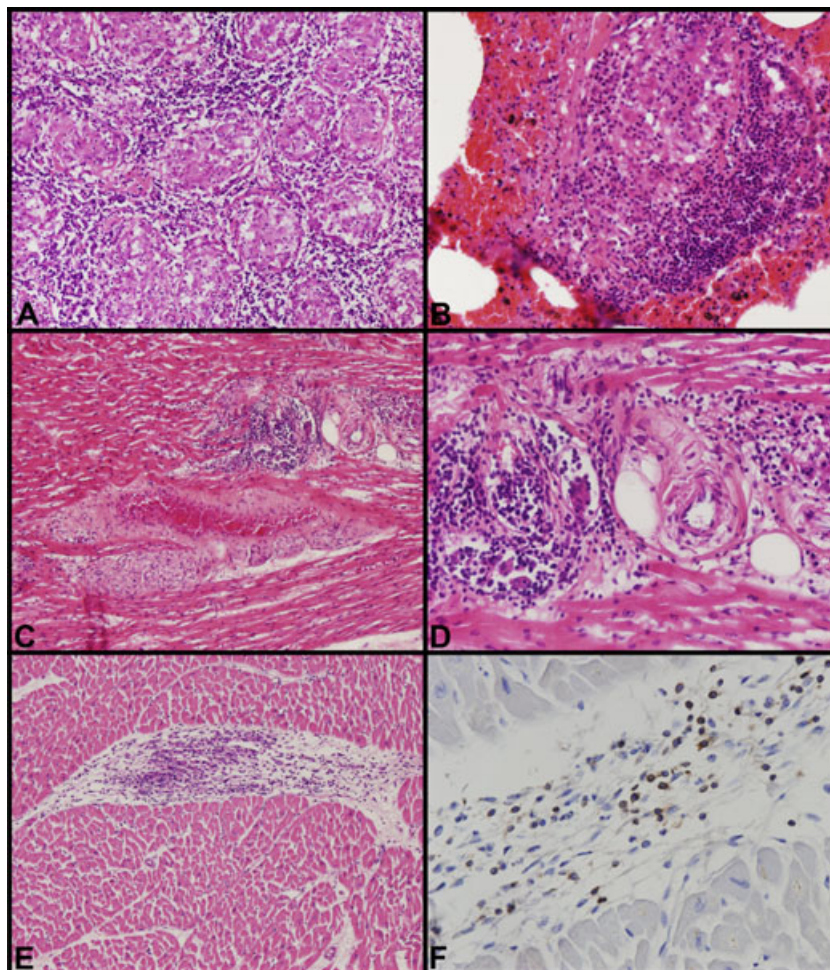


FIG. 2—(A) A mediastinal lymph node affected by sarcoidosis (hematoxylin and eosin [H&E], 100 \times). (B) Single noncaseating granuloma of the lung (H&E, 160 \times). (C) Single noncaseating granuloma surrounded by wavy myocardial fibers and perivascular fibrosis (H&E, 50 \times). (D) At higher magnification, the granuloma consists of a collection of multinucleated giant cells, lymphocytes, and macrophages (H&E, 200 \times). (E) High-power photomicrograph of the myocardium involving a granuloma composed of epithelioid cells and lymphocytes (H&E, 160 \times). (F) B-lymphocyte component of a sarcoidosis lesion (CD20, 320 \times).

sarcoidosis lesions in the ordinary myocardium (constituting the ventricular conduction system) suggested a plausible mechanism to explicate the accidental fall.

We hypothesized that, while looking out the window, the young woman might have suffered an arrhythmia related to cardiac disease undiagnosed during life, thus losing her balance and accidentally falling down into the courtyard (Fig. 1B,C).

This theory could also justify why the neighbor did not hear any scream of the victim and why no open comminuted fractures of the wrists and knees, as well as palmar and finger abrasions, were found. In fact, such type of injuries are typical signs of the victim's attempt to cushion the impact (7,8) or to hold on to objects preventing a fall (10) and clearly might be absent if the victim is unconscious (i.e., for a syncopal episode).

In conclusion, we do believe that our brief report is a good example of the powerful additional information that histological and immunohistochemical investigations of the main organs can offer for reconstructing the manner of death and the dynamics of the event in falls from a height and other traumatic deaths (18–21). Nonetheless, histology data should be considered just a piece of the complex puzzle that must be analyzed in the reconstruction of the event, which requires the integration of medical, psychiatric, and social history of the victim, circumstantial details, death scene investigation data, and autopsy findings.

Conflict of interest: The authors have no relevant conflicts of interest to declare.

References

1. Risser D, Bonsch A, Schneider B, Bauer G. Risk of dying after a free fall from height. *Forensic Sci Int* 1996;78(3):187–91.
2. Cross R. Fatal falls from a height: two case studies. *J Forensic Sci* 2006;51(1):93–9.
3. Shaw KP, Hsu SY. Horizontal distance and height determining falling pattern. *J Forensic Sci* 1998;43(4):765–71.
4. Wischhusen F, Patra S, Braumann M, Turk EE, Puschel K. Analysis of jumping/falling distance from a height. *Forensic Sci Int* 2006;3:150–3.
5. Fanton L, Bevalot F, Schoendorff P, Lalliard S, Jdeed K, Malicier D. Toxicologic aspects of deaths due to falls from height. *Am J Forensic Med Pathol* 2007;28(3):262–6.
6. Christensen AM. The influence of behavior on freefall injury patterns: possible implications for forensic anthropological investigations. *J Forensic Sci* 2004;49(1):5–10.
7. Turk EE, Tsokos M. Pathologic features of fatal falls from height. *Am J Forensic Med Pathol* 2004;25(3):194–9.
8. Katz K, Gonen N, Goldberg I, Mizrahi J, Radwan M, Yosipovitch Z. Injuries in attempted suicide by jumping from a height. *Injury* 1988; 19(6):371–4.
9. Turk EE. Fatal falls from height. In: Tsokos M, editor. *Forensic pathology reviews*. Vol. 5. Totowa, NJ: Humana Press, 2008;5.
10. Gill JR. Fatal descent from height in New York City. *J Forensic Sci* 2001;46(5):1132–7.

11. Dempsey OJ, Paterson EW, Kerr KM, Denison AR. Sarcoidosis. *BMJ* 2009;339:b3206.
12. Sharma OP, Maheshwari A, Thaker K. Myocardial sarcoidosis. *Chest* 1993;103(1):253–8.
13. Fleming HA. Sarcoid heart disease. *Sarcoidosis* 1985;2(1):20–4.
14. Roberts WC, McAllister HA Jr, Ferrans VJ. Sarcoidosis of the heart. A clinicopathologic study of 35 necropsy patients (group 1) and review of 78 previously described necropsy patients (group 11). *Am J Med* 1977;63(1):86–108.
15. Byard RW, Manton N, Tsokos M. Sarcoidosis and mechanisms of unexpected death. *J Forensic Sci* 2008;53(2):460–4.
16. Riezzo I, Ventura F, D'Errico S, Neri M, Turillazzi E, Fineschi V. Arrhythmogenesis and diagnosis of cardiac sarcoidosis. An immunohistochemical study in a sudden cardiac death. *Forensic Sci Int* 2009;3:e1–5.
17. Reuhl J, Schneider M, Sievert H, Lutz FU, Zieger G. Myocardial sarcoidosis as a rare cause of sudden cardiac death. *Forensic Sci Int* 1997;89(3):145–53.
18. Cecchetto G, Viel G, Cecchetto A, Kusstatscher S, Montisci M. Fatal splenic rupture following Heimlich maneuver. Case report and literature review. *Am J Forensic Med Pathol*. 2010. In press.
19. Cecchetto G, Feletti A, Montisci M, Fais P, Cecchetto A, Viel G. Fatal drowning accident and undiagnosed hydrocephalus. *J Forensic Sci* 2010;55(3):826–9.
20. Giorgetti R, Bellero R, Giacomelli L, Tagliabracci A. Morphometric investigation of death by asphyxia. *J Forensic Sci* 2009;54(3):672–5.
21. Karger B, Lorin de la Grandmaison G, Bajanowski T, Brinkmann B. Analysis of 155 consecutive forensic exhumations with emphasis on undetected homicides. *Int J Legal Med* 2004;118(2):90–4.

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