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Commentary

Postmortem ant activity patterns in propofol anesthetic drug overdose

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Commentary

The recently reported case by Nagar *et al.* [1] described extensive postmortem ant activity patterns in a propofol anesthetic drug overdose, mimicking antemortem traumatic injuries and posing a critical challenge for the forensic pathologist during postmortem examination, especially as the relatives of the deceased alleged foul play. A 26-year-old male anesthesiology resident was found deceased in his locked hostel room, lying supine on the bed and partially unclothed. A syringe with an attached needle and vials of propofol were recovered beside the body. Postmortem examination revealed intravenous puncture marks in both cubital fossae, pulmonary oedema with increased lung weights, and visceral congestion, consistent with propofol toxicity. Multiple reddish, irregular lesions with serpiginous margins were observed on exposed areas of the body, which, upon closer examination, were identified as artefacts of postmortem ant activity rather than antemortem injuries. There were no signs of struggle or external violence, excluding foul play. The Forensic Science Laboratory in India conducted qualitative drug analysis and confirmed the presence of propofol in the blood and viscera samples. However, quantitative estimation of the drug level was not performed due to the lack of necessary facilities. Based on the autopsy, chemical analysis, and circumstantial evidence, the cause of death was determined to be asphyxia due to self-administration of a lethal dose of propofol.

While postmortem ant artefacts are well recognized in the literature, the presence of striking bleeding patterns in the form of droplets, stripes, and pools contrasted with the more commonly described parchment-like, dry, and non-hemorrhagic ant lesions, thereby raising the potential for serious confusion in interpretation during postmortem [1].

In forensic practice, the distinction between antemortem injury and postmortem artefact is central to correct medico-legal interpretation. Among insect-related postmortem artefacts, those produced by ants remain especially deceptive. Classically, ant-induced lesions are described as small, hard, yellowish areas with serpiginous margins and an absence of bleeding [2,3]. However, reports in the literature, including a recent case documenting ant activity in a fatal propofol overdose, demonstrate that such neat descriptions do not fully encompass the spectrum of presentations [1,4–6]

Morphological Patterns of Ant Activity

Patterns of injuries present on the body are of significant importance to the forensic pathologist during postmortem examination. These patterned injuries are characteristic of the causative agents, and knowledge of such injuries is helpful in solving complex cases in legal medicine [7,8] Ants are among the earliest necrophagous organisms to reach the body of a victim. In our case, extensive ant activity was present within 13 hours of death. They are strongly attracted by the smell of blood and decomposing tissue. In this instance, the deceased self-administered the drug and lost consciousness during the act, leading to leakage of blood from the injection site, which likely caused the early appearance of ants even in an indoor setting. In outdoor scenarios, such activity could appear even earlier [5].

The patterns of ant activity depend on multiple factors, including the species involved, body position, site of activity, cause of death, blood fluidity, and clothing. Four types of patterns have been recognized by previous researchers: droplets, stripes, pools, and mixed forms. Droplet patterns typically occur when the body lies on a flat surface, preventing blood from flowing in any direction. Stripe patterns occur when the body is suspended, such as in hanging, where blood drips downward due to gravity. Pool patterns form when extensive activity occurs in dependent regions, allowing blood to collect in larger accumulations. These bleeding patterns are most commonly reported in asphyxial deaths, such as hanging, strangulation, and intoxication, where blood fluidity is increased. In addition, formic acid secreted by ants may enhance bleeding [1,5,6,9] Thus, the strict dichotomy of "bleeding = antemortem trauma" versus "no bleeding = postmortem artefact" is increasingly untenable.

Comparative Insights from Previous Research

Numerous studies have described postmortem ant activity in a wide range of contexts. Cases of hanging and strangulation have shown bleeding artefacts consistent with persistent blood fluidity in congested deaths [1,4–6]. In contrast, dry, parchment-like lesions have been reported in non-congested bodies, particularly where exposure was prolonged and decomposition was advanced [2–4].

The case under discussion expands this spectrum by documenting ant activity in a fatality due to propofol administration. Propofol deaths are rare in forensic literature, and the overlay of insect artefacts in such a case heightens interpretive complexity. Propofol acts by suppressing NMDA receptor activity and regulating calcium entry through slow calcium channels. It is a short-acting intravenous anesthetic widely used in operating theatres and intensive care units to achieve controlled, dose-dependent sedation and hypnosis. The drug exhibits a rapid onset of action, brief duration, minimal toxicity, and allows precise control of sedation. Moreover, patients typically experience quick recovery, even following extended administration. Propofol is a commonly abused anesthetic drug among doctors, particularly anesthetists, due to its accessibility, familiarity with dosing, and expertise in self-administration. Suicides following self-administration usually occur due to its potent respiratory depressant effect. Factors such as prolonged working hours, occupational stress, and attempts to relieve chronic headache contribute to misuse. This trend raises serious concerns for the medical community, as young doctors are especially vulnerable, and highlights the need for urgent changes in workplace health policies [10–14]. A thorough assessment of drug levels and identification of metabolites in tissue samples are important for confirming toxicological causes of death, as drug concentrations can change depending on the time between death and the postmortem examination. In this case, only qualitative detection of propofol could be performed, but when these findings are interpreted together with histopathological and biochemical results, they provide stronger evidence for establishing the cause of death. Examination of hair samples can also be useful in determining previous or repeated drug exposure, allowing for a more accurate and comprehensive understanding of the case.

Forensic Implications

The misinterpretation of postmortem artefacts as evidence of foul play poses a serious risk. Lesions caused by ants may mimic abrasions, lacerations, or bleeding injuries depending on their depth and distribution. The potential for diagnostic error is greatest when bleeding artefacts are present, as these closely resemble vital reactions. A systematic approach is therefore essential. Correlation with clothing distribution can assist, as covered areas are usually spared [5,6,15,16]. Histological examination also provides critical guidance, since postmortem lesions lack vital tissue reactions such as inflammatory cell infiltration, hemorrhage into surrounding tissues, or reparative changes [17,18]. Furthermore, scene investigation, particularly noting the presence of ant colonies in the immediate environment, offers valuable contextual corroboration.

Broader Patterns of Activity

Ant activity is not uniform across cases or populations. Environmental factors such as temperature and humidity directly affect the extent and morphology of lesions. Differences in species behavior may also influence outcomes, as some ants are more aggressive necrophages than others. The literature notes that necrophagous activity tends to begin at natural orifices and exposed sites, later extending to covered regions if infestation is extensive [5].

Future Perspectives

Despite scattered reports, systematic research into postmortem ant artefacts remains limited. Larger series documenting the full range of lesion morphology, bleeding patterns, and histopathological correlations are required. Experimental animal models could clarify the role of ant secretions in altering clotting dynamics and producing hemorrhagic artefacts [9].

For forensic practitioners, heightened awareness and continuing education are essential. Incorporating insect artefact recognition into medico-legal training, supported by photographic atlases and histological examples, would reduce the risk of misclassification. Journals and case reports play a vital role in disseminating such awareness, ensuring that rare presentations, such as those in toxicological fatalities, are not overlooked.

Conclusion

Ant-induced postmortem artefacts can mimic antemortem injuries and complicate forensic interpretation, especially in toxicological fatalities involving propofol. This case demonstrates that careful correlation of external findings with internal examination, histopathology, and toxicological testing is essential for accurate cause-of-death determination. Recognition of pulmonary congestion, oedema, and injection sites, together with quantification of propofol and its metabolites, improves diagnostic certainty. Integrating histopathological and biochemical data into routine autopsy practice enhances the accuracy of forensic conclusions and supports both clinical and legal investigation.

Conflict of Interest

None.

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