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Original Article

Assessment of bee-related deaths based on the scene of the incident and autopsy findings

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Abstract

Aim: Although deaths resulting from bee stings are rare, they can pose a serious public health problem due to sudden systemic reactions, particularly during periods when bees are active.

Materials and Methods: This retrospective study evaluated 11 cases of deaths due to bee stings, as reported in the Eastern Black Sea Region between 2013 and 2023, for which autopsies had been performed.

Results: All of the individuals were male, with a median age of 57. The most common cause of death was anaphylaxis due to laryngeal oedema. Fatal cases frequently occurred in the spring and summer months, typically following stings to critical areas such as the head, neck and body. Multiple bee stings, underlying cardiovascular diseases and delayed medical intervention were identified as the most significant risk factors.

Conclusion: The findings suggest that bee sting-related deaths are largely preventable, and that early detection of individual sensitivity, the use of epinephrine/adrenaline autoinjectors, and the strengthening of emergency response services are of vital importance.

Keywords: Bee sting, anaphylaxis, autopsy, forensic medicine

INTRODUCTION

The relationship between humans and animals in the wild, as well as breeds of animals raised for their products, can sometimes result in injury or death, despite providing many benefits. These outcomes can result from livestock farming, hunting and unexpected human–animal contact in nature, as well as from traumatic, toxicological or allergic pathways [1–3]. Bee stings, particularly due to the allergic reactions they cause, are one of the environmental exposures encountered, generally resulting in mild clinical presentations. However, anaphylactic reactions that develop in sensitive individuals can lead to life-threatening systemic effects within a very short timeframe [4,5]. Such reactions can be fatal, especially in the presence of predisposing factors such as a known or unknown history of allergies, cardiovascular diseases or advanced age.

According to data from the World Health Organization, although deaths due to insect stings are rare, the risk increases significantly in rural areas where adequate emergency care is unavailable. Numerous forensic case studies reported in the literature show that death often results from respiratory oedema and circulatory collapse [4–7]. In this context, forensic medicine plays a critical role in determining the causes of unexpected and sudden deaths due to bee stings.

There are few autopsy-based studies on this subject in Türkiye, and very few data sets systematically evaluate variables such as the bee species, number of stings, anatomical site, time of death and accompanying diseases [1–3]. Furthermore, supporting details such as seasonal distribution, toxicological analyses and documentation of intervention attempts could facilitate a better understanding of these deaths.

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This study aims to systematically evaluate cases of people who underwent forensic autopsies following bee stings between 2013 and 2023. The findings are expected to inform public health measures, emergency intervention protocols and legal determinations of cause of death.

MATERIAL AND METHOD

A total of 11 autopsy cases reported to have resulted from bee stings in the Eastern Black Sea Region between 2013 and 2023 were examined retrospectively . All cases were identified through the official forensic reporting system, and only those with complete case histories were included in the study. All autopsies were performed by forensic pathologists and subjected to multidisciplinary evaluation, including toxicological analysis.

The data were transferred to a standardised form and evaluated based on the following parameters: age; gender; nationality; year of death; location of incident; location of death; season; anatomical site of bee sting; number of stinging bees; bee species; whether cardiopulmonary resuscitation (CPR) and intubation were performed; underlying diseases; autopsy findings; toxicological analysis results; and forensic medical diagnosis. Cases with missing or conflicting information were excluded from the analysis. Diagnostic classification was performed by evaluating autopsy findings alongside toxicology and incident location information. In all cases, the cause of death was reported as 'anaphylactic reaction', and the deaths were confirmed as being related to bee stings through toxicological analysis. Differantial diagnosis criteria such as acute cardiac events, traumatic death and toxic substance exposure excluded.

The inclusion criteria for the study were defined as follows: the cause of death must have been directly or indirectly related to a bee sting; the autopsy must have been completed, with pathological evaluations performed; and the file must have contained basic demographic information, details of the preclinical process, toxicological analysis and histopathological findings. The dataset was created in Microsoft Excel and certain parameters were standardised. These parameters included gender and age; date and time of incident and death; the location of the sting (anatomical localisation); the number of stings; the reported species of bee (if known); the location of the incident; the duration of the intervention; the presence of a known allergy or comorbidity; the results of the toxicological analysis; the autopsy findings (e.g. pulmonary oedema, laryngeal oedema and congestion); and the cause of death (e.g. direct anaphylaxis, cardiac arrest or respiratory failure). The data were analysed using descriptive statistical methods. Qualitative variables were summarised using frequency and percentage, while quantitative variables were summarised using mean ± standard deviation and median (minimum–maximum). Graphs and tables were created using Microsoft Excel.

This study was accepted at the Education and Scientific Research Commission meeting of the Forensic Medicine Institution in response to the study proposal titled 'Evaluation of Deaths Due to Bee Stings Based on Autopsy Findings', as evidenced by the letter dated 30/04/2024 and numbered 21589509/2024/140. Ethically, the study does not require committee approval as it consists solely of data obtained for forensic purposes and does not contain any personally identifiable information. Nevertheless, the study was conducted in accordance with the principles of the Declaration of Helsinki and relevant national legislation.

RESULTS

This study retrospectively evaluated a total of 11 cases of death due to bee stings. All of the individuals . All cases were male individuals, ranging in age from 35 to 86 years old, with a median age of 57years. Figure 1 shows the age distribution of the cases. 90.9% of the cases (n=10) were citizens of the Republic of Türkiye, while 9.1% (n=1) were foreign nationals. When the distribution by year was examined, it was seen that the highest number of deaths occurred in 2023 (n=3). The other deaths were distributed across 2018 (n=2), 2017 (n=2), 2016, 2015, and 2013.

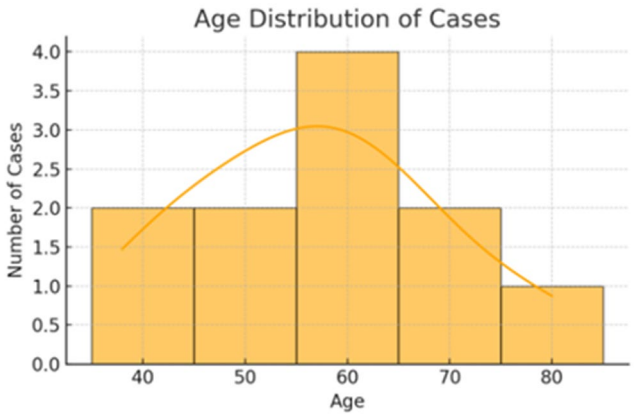

Figure 1. Most cases involve individuals over the age of 40, with the highest frequency occurring in the 50–70 age group

The 'home garden' (n=4) was identified as the most common location for fatal bee stings. Other locations included tea fields (n=2), the area around vehicles/the hive transport area (n=1), a construction site (n=1), a picnic area (n=1), a wooded area (n=1) and an unknown location (n=1). When the location of death was evaluated, it was found that all cases occurred in a hospital setting. This suggests that, despite being transported to hospital during emergency medical intervention, the interventions were insufficient and severe anaphylactic reactions developed.

Examining the seasonal distribution of cases revealed that four cases (36.3%) occurred in spring, four (36.3%) in summer, and three (27.2%) in autumn. No bee sting-related deaths were recorded during the winter months. This distribution is parallels to the seasonal characteristics of bee activity [4–6]. Figure 2 shows that the highest number of deaths occurred in spring and summer.

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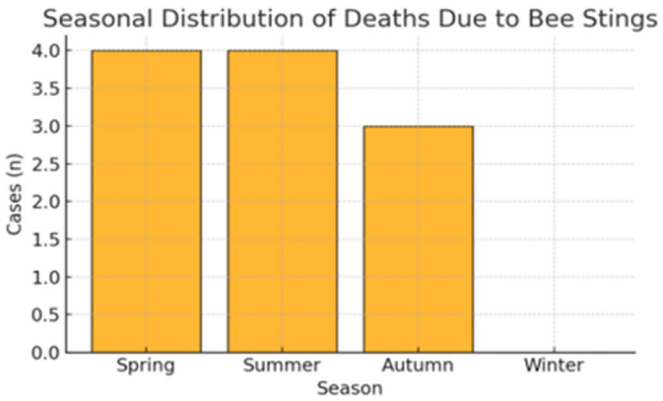

Figure 2. Seasonal distribution of bee sting-related deaths

The area most frequently stung by bees was identified as the 'face' (n=3). This was followed by 'the body in general' (n=3), 'the toe' (n=2), 'the leg' (n=1), 'the arm' (n=1) and 'an unknown area' (n=1). Figure 3 provides a statistical visual representation of the number of body areas stung.

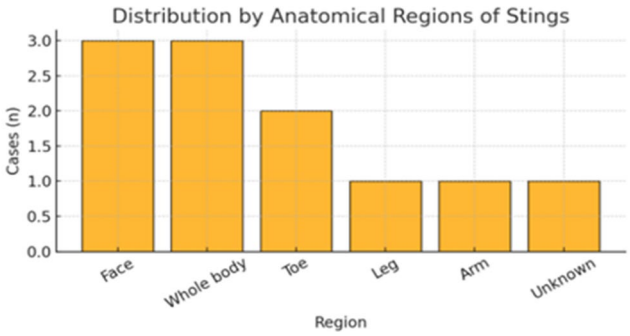

Figure 3. Distribution of stings according to anatomical site

In terms of the number of bees that stung, multiple stings were reported in 72.7% of cases (n=8). Death occurred due to a single bee sting in only three cases (Figure 4). All cases reported that the bee that stung them was a honeybee.

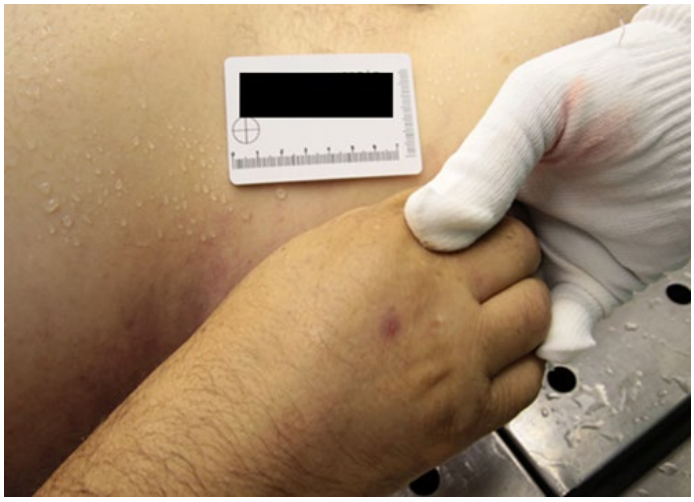

Figure 4. Autopsy photographs reveal a solitary lesion accompanied by evident erythema, oedema, and needle marks on the skin's surface

CPR (cardiopulmonary resuscitation) or intubation was performed in nine cases, indicating that pre-hospital or in-hospital emergency intervention was sought. Toxicological analyses revealed no evidence of ethanol, drug or substance use in any of the cases. Figure 5 shows that deaths due to multiple bee stings were significantly more common than those due to a single sting.

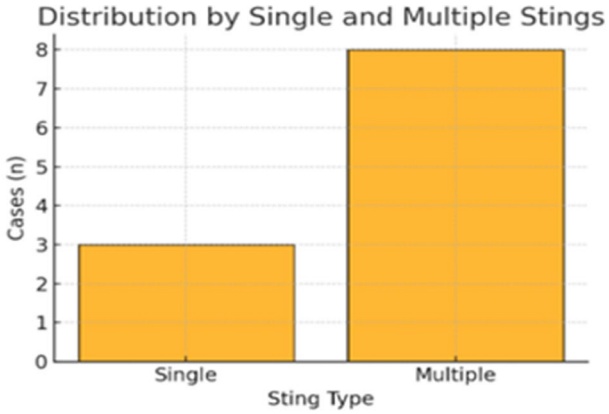

Figure 5. Distribution of cases according to single and multiple bee stings

In terms of underlying diseases, cardiovascular diseases were present in seven cases. No clear information was available in three cases and diabetes mellitus was present in one case. These findings suggest that existing comorbidities may exacerbate the clinical severity of anaphylactic reactions.

Autopsy findings were similar in all cases, with marked laryngeal oedema noted in all. This finding supports the diagnosis that the deaths were directly related to anaphylaxis. In the forensic evaluation, all cases were reported as 'anaphylaxis'. Figure 6 shows the advanced degree of laryngeal oedema based on autopsy findings. Significant oedema and hyperaemia are evident in the epiglottis and surrounding tissues, as well as in the tracheal mucosa. These findings support the diagnosis of anaphylactic shock as the cause of death.

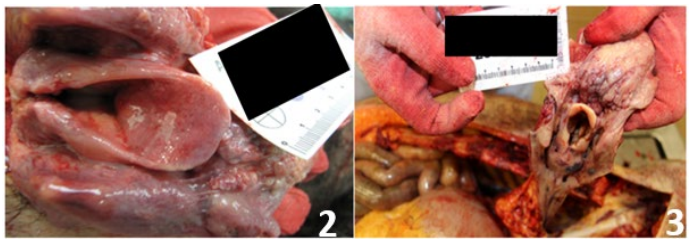

Figure 6. Selected macroscopic findings from autopsies. Laryngeal and upper airway oedema was observed in most cases included in the study. The photograph shows typical laryngeal oedema and mucosal hyperaemia. There is an advanced degree of laryngeal oedema. Significant oedema in the epiglottis and surrounding tissues, as well as hyperaemia in the tracheal mucosa, can be seen. These findings support anaphylactic shock as the cause of death

DISCUSSION

Honey production is an important source of livelihood throughout Türkiye. The Eastern Black Sea Region is also an area where beekeeping is widely practised, with various types

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of honey produced from the region's endemic flora, mostly by amateur beekeepers. This study retrospectively examined forensic autopsy and toxicological data from 11 cases of death due to bee stings between 2013 and 2023. The findings show that, as reported in the international literature, deaths due to bee stings in Türkiye mostly occur as a result of sudden systemic reactions [1,2]. Bee stings, particularly from honey bees (Apis mellifera) and wasps (Vespula species), can lead to anaphylactic shock and death within a short period of time in susceptible individuals [8,9].

In most of the cases included in our study, deaths occurred in spring and summer. This is consistent with the seasonal distribution commonly reported in the literature. The increase in the bee population, particularly between June and September, combined with the increased frequency of people being outdoors, significantly increases the risk of exposure. The seasonal trend is more pronounced for individuals living in rural areas or in close contact with nature (Figure 7). This situation is consistent with our study, where the majority of cases were exposed to bee stings in rural areas, outdoors [10].

Figure 7. An example of amateur beekeeping activities in the Eastern Black Sea Region. The combs built on the region's unique flora reflect the natural environment where bee stings are common

In most cases, the stung area was the head-neck or torso, and it is known that stings in these areas cause more severe systemic effects [11]. The dense vascularization in these anatomical regions and the faster passage of toxins into the circulation may explain this result. Furthermore, in stings around the throat, tongue, or windpipe, rapid development of edema can obstruct the airway, leading to sudden death. Indeed, some cases report death occurring very quickly, with the individual dying at the scene.

Another noteworthy finding in the study is the presence of multiple bee stings. It is known that toxic effects increase with the number of bee stings [12]. Serious toxic reactions and multiple organ failure can develop in non-allergic individuals, especially in cases of multiple bee stings. This condition is defined in the literature as “toxic envenomation” and can result in death in some cases without anaphylaxis. In our study, rapid systemic responses resulting in death were observed in several cases known to have been stung by ≥10 bees. However, individual factors such as underlying health conditions, as well as the total amount of venom to which the individual was exposed, may also be decisive in this process [8].

When autopsy findings are evaluated, most cases show significant oedema of the larynx and epiglottis, hyperaemia of the inner surface of the trachea, lung congestion and widespread oedema are evident in most cases. These pathological changes are consistent with the typical morphological features of anaphylactic shock [13]. While these findings are often non-specific, when considered alongside the clinical history and site of injection, it is possible to establish a strong correlation with the cause of death. Similarly, the presence of widespread oedema in the lungs indicates circulatory failure and hypoxia, resulting in a systemic inflammatory response.

In toxicological analyses, no significant alcohol or drug interactions were detected in the cases included in our study. However, the literature indicates that anaphylaxis management may be challenging, particularly in individuals taking antihypertensive, beta-blocker, or ACE inhibitor drugs. It is thought that these types of drugs may increase the risk of mortality by rendering patients unresponsive to epinephrine treatment. Therefore, it may be useful to inquire about the history of prescription drug use in future studies [10,11].

Compared to cases reported in the literature, our study's data reveal that bee sting-related deaths also account for a significant proportion of sudden deaths caused by allergies and toxicity in our country. Furthermore, the fact that most of these deaths occur in rural areas without access to emergency medical intervention highlights the importance of life-saving tools such as first aid and epinephrine auto-injectors. Community-based studies in Türkiye investigating issues such as access to these tools, their frequency of use and health literacy could help to prevent these deaths.

CONCLUSION

In conclusion, the majority of bee sting-related deaths could be prevented by taking some simple measures. Critical measures include identifying individuals at risk, conducting preliminary allergy tests, mandating the carrying of auto-injectors containing epinephrine/adrenaline, and training healthcare personnel, particularly those working in rural areas [12]. Our study is important as it is one of the few case series in forensic medicine to draw attention to this issue. In the future, this knowledge gap could be filled by studies with larger sample sizes and more rigorous designs.

Conflict of Interests

The authors declare that there is no conflict of interest in the study.

Financial Disclosure

The authors declare that they have received no financial support for the study.

Ethical Approval

Ethically, the study does not require committee approval as it consists solely of data obtained for forensic purposes and does not contain any personally identifiable information. Nevertheless, the study was conducted in accordance with the principles of the Declaration of Helsinki and relevant national legislation.

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