

Epidemiology of Death Due to Honey Bee Sting - An Autopsy Study

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Abstract: ***Objective:** This study aims to assess the clinical issues and threat factors associated with severe systemic responses following bee stings, fastening on cases treated at Government Medical College, Gondia which is known as one of the significant areas for honey bee sting cases in Central - India. **Background:** Honey bee and humans have a long - standing symbiotic relationship, where bees give essential pollination services for crops and other shops, while humans give them with coffers and watch through beekeeping. But occasionally, this relationship gets disturbed due to numerous unfortunate reasons and humans as a discipline get attacked by bees. **Methods:** In this composition, we had done a case series for a total number of six different cases of bee sting which came or admitted to Government medical college, Gondia and land up in mortuary and a post - mortem examination was conducted to know the cause of death. **Conclusion:** We found out that in cases of Honey Bee sting; the early treatment is necessary as the patient condition deteriorate rapidly which eventually leads to death due to Anaphylactic shock and its sequelae.*

Keywords: Bee sting, Honey Bee, venom, anaphylaxis, bee keeping, shock, tertiary center

1. Introduction

All bees live in colonies where workers rise as a form of defense, and surprised bees release pheromones that stimulate the response to the attacks of other bees.

The different types of honeybees differ from all other types of honeybees by the possession of small barbs on the sting, but these barbs are found only in the worker bees. (**Honey Bee Identification, 2015**) A honeybee stinger is a specialized organ used for defense and is located at the tip of the abdomen. (**University, 2017**)²⁴ The stinger delivers venom to the victim, causing pain and potentially swelling. After stinging, a honeybee's stinger and attached venom apparatus can detach from the bee, leading to the bee's death. (**Breed, 2019**)¹

The stinger consists of three parts: a central stylus and two barbed lancets (slides) on either side. The barbs on the lancets ensure that the stinger remains embedded in the skin, preventing the bee from retracting it. (**Pawelek, 2010**)² A small percentage of people are allergic to bee venom and can experience a life - threatening allergic reaction called anaphylaxis. Anaphylaxis can occur even after a single sting and can cause symptoms like swelling of the throat, difficulty breathing, and a drop in blood pressure. If left untreated, it can move towards impending death or death in worst case scenario. (**Staff, 2024**)³ In rare cases, a large number of stings (over 500 for adults, 30 - 50 for children) can lead to death due to the direct toxic effects of the venom. These effects can include hemolytic anemia, acute renal failure, and shock. Children are more susceptible to the direct toxic effects of venom due to their smaller body size. The location of stings can also influence the severity of the reaction. Stings near the

head, neck, or throat are more dangerous due to the potential for airway obstruction. Pre - existing conditions like heart problems can also increase the risk of a severe reaction. (**Jill Seladi-Schulman, 2023**)²⁵ (**Nezih Anolay, 2014**)⁴



Figure 1: Honey Bee sting in the tail (650 X) in Scanning Electron Microscope (Fisher, 2010)

2. Methodology

We used a descriptive case study of the patients came with honey bee sting in tertiary care hospital of Government Medical College, Gondia which eventually landed up in mortuary and a post - mortem examination conducted to know the cause of death. Inclusion criteria for this study required a confirmed history of bee stab wounds/stings due to the presence of documented medical documents from the perpetrator's bee and/or spiked stamps during physical examination and Exclusion criteria included patients who were carved as honeybees by other insects, responses from other routes (e. g., ingestion of bee products), and patients

with inadequate information. Data for patients meeting inclusion criteria has been collected.

3. Autopsy Findings

Table 1: Case history with final cause of death

	History	Sting Site and Number of stings	Autopsy findings of the Cases	Final Opinion/ Cause of Death
1	32 years old female with history of honey bee sting, while working in a farm, admitted and survived for 5 days until death.	Both shoulders, upper limbs, chest, abdomen & back, 27	Lungs – firm & collapsed with blood - stained frothy fluid on cut section. Spleen – pulpy, enlarged with pus pockets. Yellowish straw fluid in peritoneal cavity.	Septicemic shock in an admitted case of Honey bee stings
2	71 years old male with history of bee stings while cleaning backyard of house. Brought dead to Emergency department.	Face, neck, both upper & lower limbs and back, 18	Edema of glottis, Lung consolidations, yellowish fluid in both thoracic & peritoneal cavity.	Asphyxia due to laryngeal edema.
3	60 years old female with history of honey bee bite while working in the farm. Admitted for 1 day until death.	Scalp, face, neck, both upper & lower limbs, chest and abdomen, 16	Edema of epiglottis & ventricular folds of laryngeal inlet. Lungs – edematous with froth admixed mucous occluding the lumen upto terminal bronchioles.	Anaphylactic shock in a case of honey bee sting.
4	79 years old male with history of honey bee sting. Admitted for 2 days till death.	Face, neck, both shoulders, upper limbs and chest, 23	Edema of glottis Lung consolidations	Bilateral pulmonary consolidation in a case of Honey Bee sting.
5	63 years old male with history of honey bee sting while walking through the jungle area. Brought dead to Emergency department.	Face and neck, 30	Edema of epiglottis & ventricular folds of laryngeal inlet.	Anaphylactic shock in a case of honey bee sting.
6	62 years old male with history of honey bee sting while working in the farm. Admitted for 3 days before death.	Scalp, face, neck, both upper & lower limbs, chest and abdomen, 34	Edema of epiglottis & ventricular folds of laryngeal inlet. Lungs – edematous, froth admixed mucous occluding the lumen till terminal bronchioles.	Anaphylactic shock in a case of honey bee sting.



Figure 2: Image Showing Multiple Bee Sting Marks with Surrounding Inflammation, Reddish In Colour.



Figure 3: Image Showing Barbed Sting In - Situ.

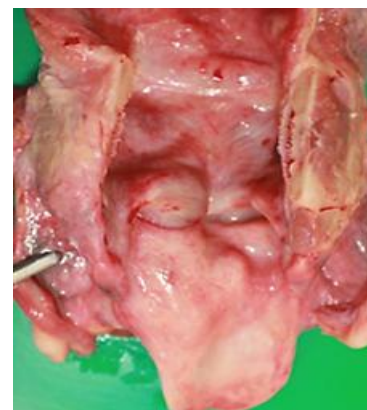


Figure 4: Image Showing the Internal Finding During Post - Mortem Examination – Oedema of Epiglottis & Ventricular Folds of Laryngeal Inlet.



Figure 5: Image Showing the Stinger and Detached Part of Lower Abdomen of Bee, Part of Intestine and Venom Sac.

Table 2: Common external and internal findings of the cases

Common External findings present in all cases during autopsy	Common Internal findings present in all cases during autopsy
1) Multiple punctured wounds with brownish thorns like structures present in the center with surrounding inflammation. 2) Generalized swelling over the body, swelling over the face, conjunctiva. 3) Congestion of oral cavity. 4) Yellowish discolouration of the skin and sclera.	1) Laryngeal oedema with severe congestion of organs. 2) Lungs were firm in consistency with straw colored fluid present in the pleural cavity. 3) Lungs were consolidated on cut section. 4) Multiple petechial hemorrhages present in the mesentery of small and large intestine.

Table 3: Histopathological and laboratory findings of the cases

Cases	Laboratory findings – *IgE Levels	Common Histopathological findings present in all cases
Case 1	250 IU/ml	Chronic inflammation with occasionally eosinophilic infiltrations & presence of Giant cells with collection of epithelioid cells. (Figure 2 and Figure 3)
Case 2	311 IU/ml	
Case 3	317 IU/ml	
Case 4	292 IU/ml	
Case 5	356 IU/ml	
Case 6	392 IU/ml	

The IgE levels in patient attacked by honey bee were found to be significantly higher than the (0 - 100 IU/ml) normal levels *.

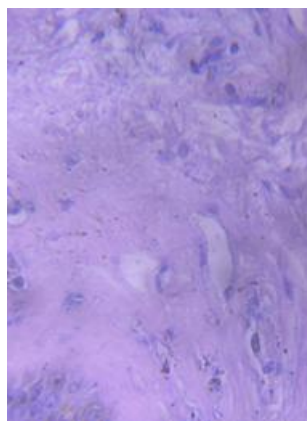


Figure 6: Collagen lysis along with mast cells. Extravasation of RBC's present.

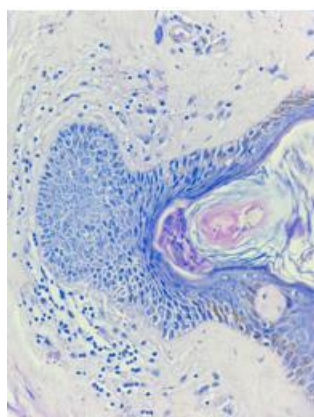


Figure 7: Chronic Inflammation with Occasionally Eosinophilic Infiltrations and Presence of Giant Cells with Collection of Epithelioid cells.

effects. Other significant peptides include apamin and mast cell - degranulating peptide. Enzymes like phospholipase A2 and hyaluronidase are also key components. (Rim Wehbe, 2019)

5. Detailed Composition:

a) Peptides:

- **Melittin:** A small protein (26 amino acids) that represents a significant portion of the dry venom (40 - 60%) and is the primary toxin causing pain and inflammation. (Jun Chen, 2016)²³
- **Apamin:** A neurotoxin that acts on the spinal cord.
- **Mast Cell - Degranulating (MCD) peptide:** Contributes to inflammation.
- **Other peptides:** Adolapin, secapin, tertiapin, and procamine A and B.

b) Enzymes:

- **Phospholipase A2 (PLA2):** The second most abundant compound, known for its allergenic and immunogenic properties. (James D Nolin, 2017)⁵
- **Hyaluronidase:** Helps the venom spread by breaking down tissues. (Esha Bala, 2018)²²
- **Phospholipase B (PLB):** Enhances the activity of PLA2.
- **Other enzymes:** Acid phosphomonoesterases, lysophospholipase, and α - glucosidase. (Christopher E. M. Griffiths (Editor), 2016)²³

c) Other Components:

- **Biogenic Amines:** Histamine, dopamine, and noradrenalin, which contribute to pain and inflammation.
- **Small Molecules:** Amino acids, carbohydrates (glucose and fructose), and lipids.
- **Minerals:** Calcium, copper, magnesium, and others. (Christopher E. M. Griffiths (Editor), 2016)²³

4. Discussion

Bee venom is a complex mixture primarily composed of water (around 88%) and various bioactive compounds in its dry state. These compounds include peptides, enzymes, amines, and other small molecules like amino acids and minerals. The most prominent peptide in bee venom is melittin, known for its pain - inducing and inflammatory

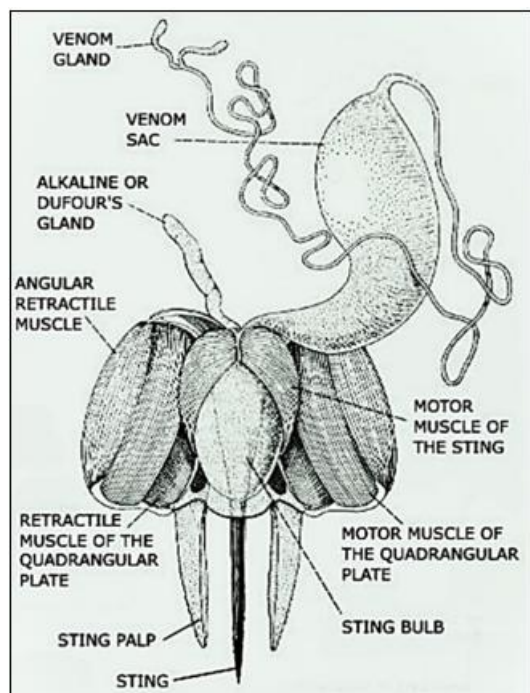


Figure 4: Honey Bee stinger apparatus and venom gland (R. S. Ferreira Jr, 2012)

Pathophysiology of Honey Bee sting: -

- The honeybee uses the lancets to pierce the skin, with the barbs acting as anchors. The lancets move back and forth, alternately pushing and pulling the stinger into the skin. As the stinger penetrates, venom is released from the venom sac into the wound. The stinger, along with the attached venom sac and parts of the bee's abdomen, becomes detached from the bee after the sting. The barbed stinger and the detachment of the venom apparatus cause a massive abdominal rupture in the bee, leading to its death. Honeybee venom contains various components, including peptides like melittin, which causes pain and can damage cell membranes. The venom also contains enzymes like hyaluronidase and phospholipase A₂, which contribute to the inflammatory response. Some individuals may experience allergic reactions to bee venom, which can range from mild to severe and require immediate medical attention. Honeybee stings can be fatal, primarily due to anaphylactic shock caused by a severe allergic reaction to the venom, or in rare cases, by the direct toxic effects of the venom itself following multiple stings. (Dorota, 2021)
- Bees sting only in defense, and during a sting approximately 50 µg of venom is injected into the skin. The barbed sting is normally left in situ, resulting in evisceration and death of the bee. Bee's venom contains three main allergens: Phospholipase A (to which most patients are sensitive), hyaluronidase (to which a smaller number are allergic) and melittin (which is an important allergen in only a few patients). The non - allergic local reaction is a toxic response to venom constituents. Ige mediated late - phase reaction or cell mediated or combination of two can happen in these cases. (Dr. AP Rayamane, 2014)
- Bee venom is an odorless and transparent liquid containing a hydrolytic mixture of proteins with acid pH (4.5 to 5.5) that bees often use as a defense tool against

predators. One drop of BV consists of 88% of water and only 0.1 µg of dry venom. The latter is an extremely complex blend of peptides including melittin, ado lapin, apamin, and MCD - peptide. It also contains enzymes, most importantly PLA₂, and compounds of low molecular weight like bioactive amines (e. g., histamine and epinephrine) and minerals. Serum tryptase is a neutral protease of human mast cells. (Riddle, 2016)

- Melittin, a peptide component of bee venom, hydrolyses cell membranes, changes cell permeability, causes histamine and catecholamine release and is responsible for local pain. It acts with phospholipase - A₂ to trigger the release of arachidonic acid, which causes cell membrane breakdown, damage of the vascular endothelium, and activation of the inflammatory response. Peptide 401 (mast cell degranulating peptide), triggers mast cells to degranulate, releasing histamine and other vasoactive peptides. Vasoactive amines, including histamine, dopamine and noradrenaline can provoke ischemia and even myocardial infarction through profound hypotension and arrhythmia, or by increasing oxygen demands through direct inotropic and chronotropic effects in the presence of preexisting ischemic heart disease. (Kevin T. Fitzgerald PhD, 2006)
- The "allergic angina syndrome" which could progress to acute myocardial infarction ("allergic myocardial infarction") was first described in 1991 by Kounis and Zavras. Allergic angina and allergic myocardial infarction are now referred to as "Kounis syndrome" this syndrome is associated with mast cell degranulation. (Dr. AP Rayamane, 2014)
- Mesothelium damage, thrombocyte and macrophage activation, cytokine, leukotriene release vascular coagulation), bradykinin and Platelet activating factor (PAF) and sometimes even the deposition of immune complexes in the basement membrane of small blood vessels and activation of the complement system may contribute to the pathogenesis of DIC.

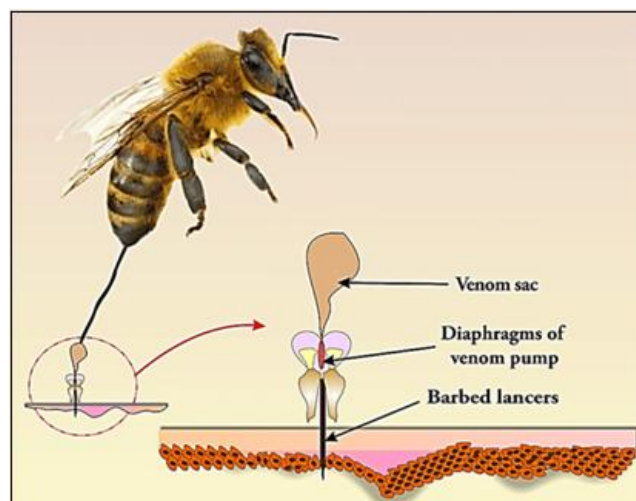


Figure 9: Structure of the venom delivery apparatus in honey bee. (Marchiori, 2024)

6. Conclusion

Proper history is necessary to establish diagnosis at autopsy. Deaths usually results from anaphylactic reaction or systemic toxicity. Bees are attracted to vibrant colors, bee signals,

typical odors – smell of deodorants, sunscreens, shampoos, after shave, Flowery prints over clothes, shining jewelry, etc. Hospitals in high aquaculture areas often suffered from bee sting wounds, which often resulted in severe systemic reactions and anaphylaxis in emergencies. To take important measures in community sensitization programs to mitigate risk, security initiatives will be provided, such as providing targeted education programs to farmers and employees working in rural and forest areas with a more highly excluded bees and hornets. Furthermore, the assurance of accessible self - combination, particularly self - directed epinephrine, is of paramount importance, particularly for those with a history of spiked reactions, in relation to repeated education.

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Conflict of Interest: None to declare.

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