

Mortality due to Mass *Hymenoptera* attacks: A Serious but Underrecognized Public Health Problem in a Mountainous State of India

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Summary

Most deaths related to *Hymenoptera* are a result of immediate hypersensitivity reactions causing anaphylaxis to one or few stings. However, if the patient is exposed to a large quantity of the venom due to mass/multiple stings, massive envenomation can cause death in nonallergic individuals. Thirty-nine cases of acute kidney injury (AKI) who followed mass attacks by *Hymenoptera* were seen over 15 years, with a reference period between 2003 and 2017. AKI was severe; most (85%) of them required dialysis and one-third died. Mass attacks by *Hymenoptera* have become a serious public health problem in tropics. There is no antivenom, and treatment in such cases is supportive. Early hospitalization is vital to reduce morbidity and mortality.

Key words: *Hymenoptera*, mass envenomation, mortality, tropics

Animal envenomations cause over 100,000 deaths each year worldwide.^[1] Most of these deaths occur in tropical countries and are due to snakebite, scorpion stings, and anaphylactic reactions to insect stings. Insects that sting to defend their colonies belong to the order *Hymenoptera*. There are two major subgroups: vespids include the yellow jacket, hornet, and wasp and apids include the honeybee and bumblebee. The stinging apparatus is used as a defense if the insect is disturbed. The stinger is detached from the body after a single sting by the honeybee, and it dies after that. However, a single wasp is capable of stinging multiple times as the stinger is not separated from the body after the sting. This finding is useful to differentiate honeybee from wasp, as wasps do not leave the stinger on the victim's skin.^[2-4] *Hymenoptera* toxins are complex mixtures of peptides, enzymes, proteins, and chemicals, and they cause cellular injury via several mechanisms.^[2] Despite the differences in venom composition and quantity released per sting, they lead to similar medical consequences, such as localized normal allergic reactions, mild-to-severe anaphylaxis and shock, and multiple-organ and tissue injury leading to multiple-organ failure.^[2] The sting becomes clinically significant if the patient has an allergy to

Hymenoptera venom or if the patient is exposed to a large quantity of the venom due to mass/multiple stings. Most deaths related to *Hymenoptera* stings are the result of immediate hypersensitivity reactions causing anaphylaxis. However, death may also occur from severe local reactions, particularly if involving the airways with subsequent respiratory obstruction. Massive envenomation during swarm attacks can likewise cause death in nonallergic individuals. The sting incidents are high during late summer or early fall when there is an increased outdoor activity of human beings or a large number of vespids are attracted to the foods of humans eating outdoors. The sting or mass envenomation occurs if the insect is disturbed or its hive is interrupted. It is an occupational hazard of farmers, and victims are usually adults of productive age group in rural areas of tropics. Little has been written in the medical literature about mass *Hymenoptera* stings in India, where many such

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Access this article online

Quick Response Code:



Website:
www.ijph.in

DOI:
10.4103/ijph.IJPH_222_18

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How to cite this article: Vikrant S, Jaryal A, Parashar A. Mortality due to mass *Hymenoptera* attacks: A serious but underrecognized public health problem in a mountainous state of India. Indian J Public Health 2019;63:154-6.

incidents have occurred in recent years. Therefore, this study was planned with an objective to report mortality due to mass *Hymenoptera* attacks.

It was a retrospective study in which the secondary data of the patients admitted at Indira Gandhi Medical College Hospital, Shimla, with animal envenomation-induced acute kidney injury (AKI) were analyzed, with a reference period between 2003 and 2017. The diagnosis of animal envenomation was based on clinical history and findings on physical examination of bite or sting marks. The medical records were evaluated for patient information on demographic factors, type of animal bite or sting, history, and clinical characteristics. Outcomes of the requirement of dialysis, survival, and mortality were analyzed. Continuous data were expressed as mean $\pm$ standard deviation, and the means were compared using an unpaired *t*-test. Nominal data were expressed as frequencies or proportions, and the Chi-square test and Fisher's exact test were used to compare the differences in frequency between the groups. The hospital is the only tertiary care hospital in the whole of the state providing nephrology services, and the data capture was complete. The institute ethics committee approved the study.

There were 181 cases (141 snakebites, 36 wasp stings, 3 bee stings, and 1 monitor lizard) of AKI due to venomous animals [Table 1]. Twenty-seven (14.9%) patients died. Thirty-nine cases of AKI followed mass attacks by *Hymenoptera* [Table 2]. All patients were from rural areas, and most were farmers in the working age group. Thirty-three (91.7%) patients with wasp sting-induced AKI required dialysis, whereas none with that due to bee stings required dialysis. Thirteen (33%) patients with AKI who followed mass *Hymenoptera* attacks died. There was no significant difference in the demographic characteristics of survival and nonsurvival groups. Mortality following wasp stings was 36.1% as compared to that of 9.2% due to snakebite ($P = 0.001$).

Further, 13 cases of multiple wasp stings were reported to the health department in the state during 2017. These incidents reportedly occurred in the circumstances leading to interruption of the vespid hive. One patient died at a secondary care hospital possibly due to anaphylaxis. Three patients were admitted to our hospital due to AKI following multiple wasp stings. Two of the three patients died, one died due to recurrent hyperkalemia, and another succumbed to the complication of acute respiratory distress syndrome.

Attacks by multiple *Hymenoptera* (i.e., mass envenomations) have become a serious public health problem in recent years in many developing countries. Accidents due to massive attack with hundreds or thousands of Africanized bees are well known in Latin America.^[3] Because of their aggressive behavior and the number of accidents associated with them, the Africanized bees are also known as "killer bees." Accidents due to multiple wasp stings have been reported from countries such as China, India, Vietnam, Thailand, Malaysia, and Nepal.^[4-10] AKI or death may result from

Table 1: Mortality due to venomous animals in a tertiary care hospital in the state of Himachal Pradesh: 2003-2017

	Total	Survived	Died	P
Number, n (%)	181 (100)	154 (85.1)	27 (14.9)	
Gender, n (%)				
Male	83 (45.9)	72 (46.8)	11 (40.7)	0.677 ^a
Female	98 (54.1)	82 (53.2)	16 (59.3)	
Age (years), mean $\pm$ SD	44 $\pm$ 15.4	44.1 $\pm$ 15.4	43.7 $\pm$ 15.8	0.914 ^b
Outcome, n (%)				
Snakebite	141 (77.9)	128 (90.8)	13 (9.2)	0.001 ^c
Wasp stings	36 (19.9)	23 (63.9)	13 (36.1)	
Bee stings	3 (1.7)	3 (100)	0	
Monitor lizard bite	1 (0.6)	0	1 (100)	

^aChi-square with Fisher's exact test, ^bIndependent sample *t*-test,

^cChi-square with Fisher's exact test for mortality between snakebite and wasp stings. SD: Standard deviation

Table 2: Mortality due to mass *Hymenoptera* attacks in a tertiary care hospital in the state of Himachal Pradesh: 2003-2017

	Total	Survived	Died	P
Number, n (%)	39 (100)	26 (66.7)	13 (33.3)	
Wasp stings, n (%)	36 (92.3)	23 (88.5)	13 (100)	0.538 ^a
Bee stings, n (%)	3 (7.7)	3 (11.5)	0	
Gender, n (%)				
Male	24 (61.5)	16 (61.5)	8 (61.5)	1.000 ^a
Female	15 (38.5)	10 (38.5)	5 (38.5)	
Age (years), mean $\pm$ SD	45.4 $\pm$ 16.7	46.8 $\pm$ 16.4	42.6 $\pm$ 17.7	0.464 ^b
Age groups (years), n (%)				
<18	3 (7.7)	2 (7.7)	1 (7.7)	0.575 ^c
18-60	26 (66.7)	16 (61.5)	10 (76.9)	
>60	10 (25.6)	8 (30.8)	2 (15.4)	

^aChi-square with Fisher's exact test, ^bIndependent sample *t*-test,

^cChi-square test. SD: Standard deviation

10 to 200 wasp stings or 150–1000 bee stings. Multiple stings result in a unique syndrome of intravascular hemolysis, rhabdomyolysis, AKI, and hepatitis. More than half of the victims who experience multiple wasps or bee stings develop AKI due to intravascular hemolysis, rhabdomyolysis, shock, and the direct toxic effects of the venom. Most patients require dialysis, and the reported mortality ranged from 9.1% to 50%.^[3-9] Overall mortality among an aggregate of 295 cases who developed AKI following multiple *Hymenoptera* stings was 19%.

Xie *et al.* reported 1091 cases of wasp stings over 3 years from Hubei Province, China, with a population of 60 million.^[10] Most (76.9%) of the cases had ten or more stings, and the in-hospital mortality was 5.1%. Forty-eight patients died of organ injury following toxic reactions to the stings, whereas six died from anaphylactic shock. The in-hospital mortality in patients with >10 stings was higher than that of ≤ 10 stings (5.2% vs. 1.0%, $P = 0.02$). Mortality observed in the study was 0.9 per million of the population.

There is no antivenom for *Hymenoptera* stings. Therefore, treatment in all patients with multiple stinging is supportive. Early hospitalization is important to reduce morbidity and mortality. *Hymenoptera* may cause both obstructive and toxic acute renal failure, in part due to hemolysis and rhabdomyolysis, resulting in the release of myoglobin and hemoglobin from myocytes and erythrocytes, respectively. All such patients should be hospitalized for aggressive hydration and urine alkalinization to prevent the AKI secondary to hemolysis and rhabdomyolysis. Provided medical intervention is timely along with the supportive therapy; there is a complete recovery of the kidney function.^[9]

Limitation of our study is that some patients might have been missed because of referral outside the state, especially for those residing in bordering areas. However, our hospital being the only tertiary care hospital in a mountainous state for nephrology services and getting the referral from all parts of the state, the capture of cases was nearly complete.

In conclusion, *Hymenoptera* stings pose a common environmental hazard in tropical countries. Mass attacks by *Hymenoptera* have become a serious but underrecognized public health problem. There is no antivenom, and treatment in such cases is supportive. Early hospitalization is vital to reduce morbidity and mortality. Aggressive hydration and urine alkalinization are advised to prevent the AKI secondary to hemolysis and rhabdomyolysis. There is an urgent need to create awareness in public for seeking medical care in such cases.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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