

Bee Sting Anaphylaxis in an Urban Population of South Australia*

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Stings by the domestic honey bee (*Apis mellifera*) are a common occurrence among the Australian population. This probably relates to the tradition of a lightly clad outdoor life-style, the warm environment and the ubiquitous presence of nectar-gathering bees. The clinical manifestations resulting from a bee sting are quite varied.¹ Most individuals develop a local reaction due to the inherently toxic and vasoactive components of bee venom. A small number develop immediate hypersensitivity or anaphylactic reactions, the severity of which varies greatly. Rarely are delayed reactions described.²

Anaphylactic reactions are frightening and potentially fatal, although death from bee stings is uncommon in Australia. With the recent availability of purified bee venom for desensitisation, it is now possible to protect individuals allergic to bee sting from such reactions. Bee venom desensitisation has been shown to be highly efficacious, but it is associated with a high incidence of side-effects; also it is costly and the duration of treatment is uncertain.³

An impressively large number of people come to our hospital for treatment of bee sting anaphylaxis. Furthermore, we have recently determined that South Australia has the highest frequency of bee-sting-

SUMMARY The clinical manifestations and circumstances of bee sting anaphylaxis have been studied retrospectively in 98 subjects. Most reactions occurred in children but the most severe reactions were seen in adult males, of whom 7 lost consciousness and 2 required cardiopulmonary resuscitation. Most stings causing anaphylaxis occurred on the unprotected feet whilst the subject was on lawn in the afternoons in December, January and February when the maximum daily temperature was between 20 and 30°C. This is the temperature range when bees are particularly active in gathering pollen. However, a significantly greater frequency of anaphylactic reactions occurred at higher temperatures when bees are less active, suggesting that high environmental temperature may predispose the individual to greater exposure to bees or possibly to anaphylactic reactions *per se*. The presence of atopy did not appear to predispose subjects to bee venom hypersensitivity. Considerable anxiety and lifestyle alteration were identified in some subjects. The alleviation of this anxiety is considered an appropriate indication for bee venom immunotherapy.

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related deaths in Australia.³ Therefore, we undertook the present study to increase our knowledge about bee sting anaphylaxis in this region.

METHODS

Flinders Medical Centre services a population of approximately 300,000 people, the majority of whom live in the southern suburbs of Adelaide. Between 1976 and mid-1983, a total of 98 subjects had attended the centre for treatment of systemic reaction to bee stings. Besides conducting a review

of their case notes, a questionnaire was sent to all the subjects. It was designed to ascertain information on the subjects' clinical manifestations and the circumstances associated with the anaphylactic reaction, their tendency to experience crescendo reactions and any change in life-style related to anxiety owing to bee-sting allergy.

The atopic status of 26 of the subjects was assessed using prick

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skin tests to three common allergens: rye grass pollen, house-dust mite extract and cat dander. A reaction was considered positive if a wheal larger than 2 mm in diameter developed to one or more of the allergens. Histamine (10 mg/ml) was used as a positive control. The results of these prick skin test were compared with those obtained from 40 unselected medical students and nursing staff, all of whom were under 40 years of age.

To assess the relationship between bee sting anaphylaxis, month, time of day and environmental temperature, we noted the date of attendance at the Centre for treatment of sting anaphylaxis and correlated this with the maximum temperature for that day as reported by the Bureau of Meteorology. The temperature distribution for the years 1981 and 1982 was also obtained from that source. It should be noted that in South Australia the maximum daily temperature in summer occurs between 3 and 6 p.m.

RESULTS

The mean age of the 98 bee sting victims was 15 years (range 2-52 years) and there were 75 males and 23 females. Sixty of the victims were aged less than 20 years and six were aged 40 years or older. Seventy-five questionnaires were returned but not all questions were satisfactorily completed and hence the sample size varies according to each question. It should be noted that the data obtained refer to the worst bee sting reaction which each victim had experienced.

Clinical manifestations and circumstances of sting

The clinical manifestations of the anaphylactic reactions and the frequency of those reactions are listed in Table 1. Other symptoms reported, but not shown on Table 1, include paraesthesia, numbness, hoarseness, profuse perspiration, abdominal pain, drowsiness, agita-

tion and severe distress. Eight subjects lost consciousness (seven males aged between 14 and 45 and one female aged 38) and two of them (males aged 32 and 45) required cardiopulmonary resuscitation.

Some victims developed symptoms within one minute of being stung. In 25 of 69 of them, their symptoms developed within five minutes and 63 of the victims developed their symptoms within 20 minutes. Four developed initial symptoms after one hour.

Thirty-four of 68 victims were stung on the feet and 29 of these were not wearing foot-wear. Of the five that were, their foot-wear was

either sandals or thongs. Twelve victims received stings on the head and neck and 10 on the hand. Half of the victims (37 of 74) were on a lawn when stung and 30 per cent (22 of 74) specifically reported being on a lawn of flowering clover. Five were stung whilst swimming.

Relationship between anaphylaxis, month of year, time of day and environmental temperature

Anaphylactic reactions occurred predominantly between the summer months of December and February with none being recorded in the winter months of June and July (Table 2). The majority (72%) of the reactions occurred in the afternoon with 15 per cent in the morning and 13 per cent in the evening.

Table 3 demonstrates the relationship between anaphylactic reactions, the maximum temperature of that day and the proportion of days of the year in that temperature range. It may be observed that 37 per cent of the reactions occurred on days with a maximum daily temperature of 30°C or higher. This percentage is significantly greater than the proportion of days of the year with those temperatures ($p < 0.001$, Chi-square).

Atopy and histamine sensitivity

No clear association was found between anaphylactic reaction and the atopic status of the victims as defined by prick skin testing, nor with histamine sensitivity, when compared with the control population (Table 4).

History of crescendo reactions

Forty-four per cent (18 of 41) of the victims reported that their

Table 1 Frequency of clinical manifestations of bee sting anaphylaxis in 69 subjects.*

Symptoms	Per cent
Urticaria	77
Local swelling	74
Facial swelling	70
Breathlessness	65
Wheeze	55
Dysphagia	47
Dizziness	39
Fainting	39
Coughing	31
Visual impairment	28
Headache	27
Tongue swelling	23
Nausea	21
Vomiting/Diarrhoea	14
Loss of consciousness	12
Others (see text)	26

*Data obtained retrospectively from questionnaires and refer to worst reaction experienced.

Table 2 Incidence of anaphylactic reactions per month of year and mean maximum monthly temperature

Month	Jul	A	S	O	N	D	J	F	M	A	M	Jun
No. of reactions	0	2	4	6	9	22	23	13	7	5	7	0
Mean maximum temp °C	15	16	19	22	26	28	29	30	25	23	19	16

Table 3 Relationship between anaphylaxis and maximum environmental temperature for that day

Maximum daily temp (°C)	% of reactions/temp range	% of No. of days/year/temp range*
10 – 14	2	7.5
15 – 19	9	35
20 – 24	28	25
25 – 29	24	17
30 – 34	17	9.5
35 – 39	12	5
≥40	8	1

*Mean calculation for the years 1980 and 1981.

Table 4 Atopic factor in subjects allergic to bee stings compared with control population

Atopic parameter	Bee allergy group	Controls	Comparison*
Positive prick skin test	13/26**	29/40	NS
Histamine 10 mg/ml (mean wheal diameter in mm)	5	7	NS

*Number of positive responses/total number of subjects studied.

**Analysis by Chi-square with correction for number of comparisons.

NS = not significant ($P > 0.05$).

worst reaction was preceded by a less severe reaction; however, on close examination, it appeared that only five subjects had a good history of crescendo reactions to sequential bee stings. Those five were all between 32 and 45 years of age and the last sting in all cases resulted in a loss of consciousness.

Anxiety and life style

When asked to grade their level of anxiety (none, slight, moderate or severe), 87 per cent indicated some degree of anxiety with 22 per cent grading their anxiety as severe. We also received additional replies from parents expressing their fear and concern about their child's allergy to bee stings. The majority (91%) of subjects reported that they wore foot-wear more often following their reaction, although several parents found this difficult to enforce, and 30 per cent reported that they had changed the composition of their gardens and lawns.

Twenty per cent reported that they had reduced their summer outdoor activities; two individuals had changed their occupations and two the location of their homes.

DISCUSSION

With regard to the Australian population, the prevalence of anaphylactic reactions to insect stings and bites and the frequency with which individuals develop these reactions are factors not known. In both South and Western Australia bee stings cause the vast majority of these reactions.⁵ Stuckey and others⁶ have determined that 15 per cent of the Busselton population of Western Australia have bee-venom-specific IgE antibody. However, it is probable that other risk factors are operative as not all individuals with venom-specific IgE develop anaphylactic reactions following a sting, and these reactions may occur uncommonly in the absence

of demonstrable venom-specific IgE.^{7,8}

From our study we have observed that the clinical manifestations of bee sting anaphylaxis are multiple and varied and our findings agree with those of other descriptive studies.^{4,9} The most severe reactions with loss of consciousness occurred in adults, particularly males. This is of some interest because this is the sex and age group in which fatalities occur.¹⁰ Children, whilst more prone to bee-sting anaphylaxis, tolerate their reaction better than adults and rarely die.¹¹ A clear history of sequential crescendo reactions appeared to define a small group at high risk from severe anaphylactic reactions.

Half of our subjects were stung on the foot and the majority were without foot-wear and were on lawns at the time they were stung. This finding strongly endorses the practical advice for individuals allergic to bee sting that they should wear protective foot-wear when outdoors. Thongs and sandals do not offer full protection as several subjects were stung while wearing this type of foot-wear.

Most anaphylactic reactions occurred in the afternoons of December, January and February and on days with maximum temperatures between 20° and 30°C. Risk was greatest at high environmental temperatures (> 30°C). A number of factors are relevant in explaining these findings. Bees are particularly active in gathering nectar at temperatures between 20° and 30°C.¹² At temperatures approaching 38°C and higher, bees seldom forage except for gathering water and generally remain within the hive or cluster on the outside of it.¹² Water-gathering is greatly increased under hot, dry conditions as it is required for cooling and humidifying the interior of the hive and for diluting honey as larval food.¹² A further factor explaining the seasonal incidence of sting anaphylaxis may be related to a seasonal variation in venom produc-

tion. Venom production in worker bees is highest during the summer months while the hive is at its peak activity.¹³ A final factor is the life style in Australia. From mid-spring to mid-autumn people wear less clothing and foot-wear, spend more time out of doors and gather around swimming pools. Thus, people are at increased risk of being stung owing to enhanced exposure. We cannot offer a satisfactory explanation for the disproportionately high prevalence of anaphylactic reactions occurring at high environmental temperatures (> 30°C) as this does not correlate with the behaviour (such as aggressiveness) or the activities of bees other than their water-gathering on hot, dry days. Perhaps it is a result of increased human exposure as people seek relaxation near swimming pools and lawns etc. when the temperature is high. It is also possible that anaphylactic reactions to any cause occur more frequently at a high environmental temperature, as has been suggested by Rubenstein.¹⁴

The presence of atopy did not appear to predispose our subjects to bee sting anaphylactic reactions and this conclusion is in accord with the findings of other investigators.^{15,16} However, it should be noted that our control group showed an unexpectedly high frequency of positive reactions to three common environmental allergens (72%). The explanation for this is obscure, although other investigators have observed the high prevalences of atopy in South Australia.¹⁷

The majority of patients attending the Centre for treatment of bee sting anaphylactic reaction were under 30 years of age. Although bee

sting anaphylaxis is common in this age group, it rarely leads to a fatal outcome¹⁰ and in the last 20 years in Australia there have been only three recorded fatalities in individuals aged between 6 and 30 years.⁴ Our current approach is to strongly reassure bee-sting-allergic individuals, advise them about high risk situations (e.g. wearing foot-wear on lawns), and to provide them or their parents with a pre-packed adrenaline syringe and instruct them on its use if stung again. However, for certain selected individuals and for those over 30 years of age, we advise bee venom immunotherapy. Our present indications for this therapy are:

(1) a history of an anaphylactic reaction to a bee sting

(2) a positive skin test to bee venom (or positive RAST)

(3) one or more of the following factors

– age greater than 30 years

– history of crescendo reaction to bee stings

– high risk from stings (e.g. bee-keepers)

– markedly restricted life style or gross anxiety owing to fear of bees.

Expertise and adequate facilities must be available for giving venom immunotherapy.

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