

# Studies of 400 Hymenoptera sting deaths in the United States

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*Data from 400 cases of Hymenoptera sting deaths in the United States have been collected. These included 100 cases seen at autopsy and the results of postmortem abnormalities and certain other correlations are tabulated.*

During the past 10 years the Insect Sting Subcommittee has accumulated data from over 400 fatal reactions recorded as due to one or more Hymenoptera stings. One hundred autopsy findings are part of this report.

The primary fatal pathology in 50 patients seen at autopsy was in the respiratory tract (35 cases), vascular system (6 cases), a result of anaphylactic shock (6 cases), and in the neurologic system (3 cases). These were reported in 1967.<sup>1</sup> Table I shows the numerical similarity of the types of pathology in the first, and a second group of 50 cases, just completed.

Table II shows a summary of the sites and the type of pathology found in the 69 respiratory tract cases, where one or both factors of massive edema and secretions had resulted in fatal obstruction.

Table III shows vascular factors of primary importance in 12 cases. The relationship of advanced coronary disease has been reported by O'Connor and associates.<sup>2</sup>

Table IV shows the findings in 12 cases with the pathologic diagnosis of anaphylactic shock. The types of lesions are similar to those given in the respiratory and vascular cases, but are milder in degree. For example, edema and secretions were not completely obstructive.

Table V shows 7 cases with primary neurologic system involvement. The first case, with death in a few minutes from massive cerebral edema, had a previous systemic reaction from a sting 3 weeks previously.

In the 400 cases there were 7 fatalities due to septicemia following Hymenoptera stings. Six died within 13 days after the stings.

In this total of 400 fatalities there were 6 patients who were receiving injection therapy. Five had received fatal stings between 4 and 14 days after their most recent injection.

Table VI shows ancillary factors such as age, type of insect, and number of stings in the 100 postmortem cases. In the age columns, 64 per cent were under

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**TABLE I.** Sites of primary pathology in 100 cases of fatal Hymenoptera sting reactions

| Pathology          | Number of cases |                 |            |
|--------------------|-----------------|-----------------|------------|
|                    | First 50 cases  | Second 50 cases | Percentage |
| Respiratory tract  | 35              | 34              | 69         |
| Vascular system    | 6               | 6               | 12         |
| Anaphylactic shock | 6               | 6               | 12         |
| Neurologic system  | 3               | 4               | 7          |

**TABLE II.** Primary respiratory tract pathology in 69 cases of fatal Hymenoptera sting reactions

| Sites                                                                             | Edema | Secretions | Other pathology |
|-----------------------------------------------------------------------------------|-------|------------|-----------------|
| Upper respiratory tract<br>(pharynx, epiglottis, larynx)                          | 33*   | 23*        |                 |
| Lower respiratory tract<br>(trachea, bronchi, lungs)                              | 30*   | 28*        | Lungs           |
| Other lung pathology: hemorrhage, 10 cases; atelectasis, 6 cases; bullae, 3 cases |       |            |                 |

\*In some cases.

**TABLE III.** Primary vascular pathology in 12 cases of Hymenoptera fatal reactions

| Pathology                                                                          | First 50 cases | Second 50 cases | Percentage |
|------------------------------------------------------------------------------------|----------------|-----------------|------------|
| Coronary occlusion                                                                 | 2              | 3               | 5          |
| Generalized hemorrhage                                                             | 2              | 1               | 3          |
| Generalized vascular engorgement of organs                                         | 2              | 1               | 3          |
| Extracardial infarction with emboli in lungs, spleen, left and right femoral veins |                | 1               | 1          |
| Total                                                                              |                |                 | 12         |

**TABLE IV.** Pathological findings in 12 cases of fatal sting reactions diagnosed as anaphylactic shock

| Pathology (in one or more organs or sites)       |
|--------------------------------------------------|
| 1. Vascular (engorgement, hyperemia, hemorrhage) |
| 2. Edema, "congestion"                           |
| 3. Excess secretions                             |
| 4. Alveolar rupture, bullae, emphysema of lungs  |

50 years of age. The vascular group was the only one in which the number of individuals over 50 years of age exceeded those under 50 years. In 5 of the cases over 50 years of age, there was extensive coronary disease. In the types of insects causing the reactions, the bees totaled 44 per cent, wasps and hornets, 26 per cent, yellow jackets, 18 per cent, and unknowns, 12 per cent.

In comparisons of the number of stings with the various types of pathology, 78 per cent had only 1 to 4 stings. Sixteen per cent had over 4 stings. Twelve of the cases with more than 4 stings were in the respiratory group.

**TABLE V.** Primary cerebral pathology in 7 cases of fatal sting reactions

| Duration of reaction in days | Number of cases | Edema | Pathology in brain and spinal cord |            |                           |
|------------------------------|-----------------|-------|------------------------------------|------------|---------------------------|
|                              |                 |       | Hemorrhage                         | Infarction | Necrosis and degeneration |
| Minutes                      | 1               | 1     |                                    |            |                           |
| 1-5 days                     | 3               | 2     | 2                                  |            | 3                         |
| 14 days                      | 1               |       | 1                                  | 1          | 1                         |
| 115 days                     | 1               |       |                                    |            | 1 (severe)                |
| 150* days                    | 1               | 1     |                                    | 1          | 1                         |

\*Permanent coma after sting; clinical diagnosis: anoxic encephalopathy.

**TABLE VI.** Comparisons of types of pathology with age of patient, kind of insects, and number of stings

| Pathology   | Age        |               | Insects  |                 |               |    | No. of stings |        |   |
|-------------|------------|---------------|----------|-----------------|---------------|----|---------------|--------|---|
|             | % 0-50 yr. | % Over 50 yr. | Honeybee | Wasp and hornet | Yellow jacket | ?  | 1-4           | Over 4 | ? |
| Respiratory | 48         | 21            | 29       | 18              | 12            | 10 | 52            | 12     | 5 |
| Vascular    | 4          | 8             | 8        | 2               | 2             | 0  | 9             | 3      | 0 |
| Anaphylaxis | 7          | 5             | 4        | 4               | 3             | 1  | 11            | 1      | 0 |
| Neurologic  | 5          | 2             | 3        | 2               | 1             | 1  | 6             | 0      | 1 |
| Total       | 64         | 36            | 44       | 26              | 18            | 12 | 78            | 16     | 6 |

? = Unknown.

**TABLE VII.** Time from sting to termination compared with the type of pathology

| Time                  | Type of pathology |              |          |            |
|-----------------------|-------------------|--------------|----------|------------|
|                       | Respiratory       | Anaphylactic | Vascular | Neurologic |
| 0-60 min.             | 46)               | 9            | 3        | 1          |
|                       | ) 87%             |              |          |            |
| 1-6 hr.               | 14)               | 2            | 6        |            |
| 6-96 hr.              | 6                 |              | 1        |            |
| Over 96 hr.           | 1                 |              | 2*       | 6          |
| Unknown               | 2                 | 1            |          |            |
| Total number of cases | 69                | 12           | 12       | 7          |

\*The first patient developed multiple emboli that progressed to multiple infarcts of the lungs, spleen, and blood vessels, and an organized thrombus was found in the aortic wall. The second patient developed a fatal generalized hemorrhagic reaction 10 days after a sting.

The sites of stings showed 43 per cent in the head and neck, 27 per cent in the extremities, and 9 per cent in the trunk. Sites were not listed in 33 cases. Some cases had stings in 2 or more body areas.

Table VII shows the elapsed time from sting to fatal result in the various types of pathology. In the respiratory group, 87 per cent died within 6 hours. In at least 7 per cent death did not occur until between 6 and 96 hours after the stings, but the pathology of edema and hypersecretion was similar to the more immediate respiratory group deaths. Most of the anaphylactic and the vascular groups likewise had an early termination. Two vascular cases had a fatal outcome after 96 hours from the time of sting. One death was the result of multiple emboli, and the other death resulted from generalized hemorrhages

**TABLE VIII.** Comparison of time of onset of sting reactions in 100 fatal and 100 nonfatal severe cases

| Cases        | Time of onset of reaction after sting |            |         |          |         |         |
|--------------|---------------------------------------|------------|---------|----------|---------|---------|
|              | 0-30 min.                             | 30-60 min. | 1-6 hr. | 6-24 hr. | 24+ hr. | Unknown |
| 100 nonfatal | 96%                                   | 1.4%       | 2.6%    | —        | —       | —       |
| 100 fatal    | 49%                                   | 14%        | 13%     | 1%       | 8%      | 15%     |

**TABLE IX.** Time from sting to beginning of treatment

| Cases        | 0-10 min. | 10-30 min. | 30-60 min.           | Over 60 min. | No treatment | No information |
|--------------|-----------|------------|----------------------|--------------|--------------|----------------|
| 100 Nonfatal | 15%       | 22%        | 50% (first hr., 87%) | 4%           | 8%           | 1%             |
| 50 fatal     | 0%        | 0%         | 6%                   | 18%          | 66%          | 10%            |

throughout the body. Six of the neurologic cases shown in Table V had a delayed fatal outcome from 5 to 150 days after stings.

Table VIII shows a comparison between the time of onset of sting reactions in severe or third-degree effects in 100 nonfatal cases, reported by us in 1970,<sup>3</sup> and the present 100 fatal reactions. The third-degree reactions included one or more of the following: syncope, severe urticaria and angioedema, severe respiratory obstructions, and severe vascular disturbances. This table shows that all of the nonfatal reactions began within 6 hours from the stings; whereas in at least 9 per cent of the fatal reactions, the onset of symptoms occurred after a 6 hour incubation. In 15 per cent the time of onset was unknown.

Another important factor in the fatal outcome is the lapse of time between the sting and the beginning of treatment. Table IX, taken from the same non-fatal reaction study, shows that 87 per cent of the patients received treatment in the first hour after the stings. Note the difference from the small number of only 6 per cent in the first 50 of our cases seen at autopsy who received some kind of treatment within the first hour after the sting.

No definite information was available as to where the stings occurred in 317 cases, but the death certificates showed that 36 were dead on arrival at a doctor's office and another 32 were dead on arrival at a hospital.

Loss of time after stings before treatment has been due to distance, ignorance as to where to go, and delays of response to emergency calls. However, at least 48 of the 400 cases received their stings at home, where a quick auto trip to a hospital might have been lifesaving.

Allergic factors relating to the fatal outcome include evidence that 59 of the 400 were known to have Hymenoptera sensitivity. Another 14 individuals were known to have other allergies. Eight known Hymenoptera-sensitive people had been advised to receive desensitizing injections but failed to do so. There were 26 cases known to have had no reaction to a previous sting. In numerous cases, there was no mention of allergic histories. Additional evidence that an allergic reaction was the primary factor in these fatalities has been brought out in our

previous reports.<sup>1, 3, 4</sup> It is strengthened here where 78 per cent had only one to 4 stings against 16 per cent with over 4 stings. The number of stings was unknown in 6 per cent.

Two fatalities with striking pathologic findings include a neurologic reaction<sup>5</sup> in a middle-aged female hospitalized 8 days after one yellow jacket sting. The right arm, trunk, and leg were weak. Sensory loss occurred 8 weeks later, with progressive deterioration and death 115 days after the sting. Autopsy showed general brain degeneration and marked perivascular infiltration of neutrophils and lymphocytes. Similar neurologic fatal and nonfatal reactions have been reported.<sup>2, 6, 8</sup>

The other fatality was a vascular case of an 18-year-old male with a negative allergic history. In coma 5 minutes after a bee sting on his hand, he had temporary cardiac arrest. He received intensive hospital care, and oral hemorrhage appeared at 3 hours. Diagnosis of defibrination syndrome was made. Death occurred at 24 hours. Postmortem examination showed massive hemorrhage of body cavities and tissues. We have 2 more similar fatal cases. One was detailed by Herrera in 1962.<sup>9</sup> A comparable reaction is on record of a child who recovered after one month.<sup>10</sup>

## SUMMARY AND RECOMMENDATIONS

United States Vital Statistic Data indicates that fatal reactions occur from Hymenoptera insect stings in over 30 persons a year.

It is believed that this study establishes the fact that 4 main types of pathology, i.e., respiratory, vascular, anaphylactic, and neurologic, are responsible for the fatal reactions discussed. A one to 2 per cent incidence of fatal bacterial septicemia has occurred in this 400 case series. Sixty-nine per cent of the fatal reactions were due to respiratory tract obstruction from massive edema and secretion. In addition, partial respiratory obstruction contributed to the 12 per cent of cases diagnosed as anaphylactic reactions.

Prognosis as to results of one or several stings cannot always be made from negative or allergic histories, nor from the type of insect nor age of patient. Eight third-degree reaction cases recovered without treatment.<sup>3</sup>

The earliest possible emergency treatment for systemic sting reactions is imperative. Patterson<sup>11</sup> in 1960 discussed allergic emergencies. I outlined a series of procedures for these patients in 1966.<sup>4</sup>

Our records show that 67 per cent of the patients whose sting was severe and nonfatal had received early doses of aqueous epinephrine 1:1,000. Isoproterenol alone had been relied on in an appreciable number of fatal reactions. Emergency kits, the use of which is understood by the sensitive patients, should always be available. Following immediate emergency treatment, an immediate trip to a physician or a hospital may be of vital importance.

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