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# Anaphylaxis in Children: A 5-Year Experience

Susan D. Dibs, MD and M. Douglas Baker, MD

**ABSTRACT. Objectives.** To identify the causative agents, presenting signs and symptoms, and course of disease in children diagnosed with anaphylaxis.

**Design.** Five-year retrospective chart review.

**Setting.** Urban children's hospital pediatric emergency department, operating suite, and inpatient units.

**Participants.** Fifty-five cases of anaphylaxis in 50 patients 1 to 19 years of age.

**Interventions.** None.

**Results.** The most common inciting agents in this population were latex (27%), food (25%), drugs (16%), and venoms (15%). Thirty-two cases (58%) occurred outside of the hospital, including 3 of 11 severe cases. Nineteen (35%) had histories of prior allergy to the causative agent. Most agent exposures were intravenous (38%), oral (27%), or dermal (20%). The most common systems involved were respiratory (93%), skin (93%), cardiovascular (26%), and neurologic (26%). Features distinguishing the 11 patients requiring intensive care included latex agents (45%), nonenteral route of exposure (91%), and presence of cardiovascular symptoms (45%). Of the 17 patients with known past anaphylaxis, only 5 had epinephrine self-administration devices available, and 3 had used them.

**Conclusions.** (1) Most patients with anaphylaxis present with skin or respiratory symptoms. (2) Severely ill children more commonly have nonenteral and/or latex exposures that occur in the hospital. (3) Most children with anaphylaxis have no stated histories of prior reaction to the causative agent. (4) Those patients who have had past episodes of anaphylaxis infrequently have epinephrine self-administration devices available for use. *Pediatrics* 1997;99(1). URL: <http://www.pediatrics.org/cgi/content/full/99/1/e7>; *anaphylaxis, allergy, latex*.

ABBREVIATIONS. IV, intravenous; ICU, intensive care unit.

Anaphylaxis is a medical emergency requiring immediate recognition and treatment. The vast majority of published material regarding adult and pediatric anaphylaxis has occurred in the form of case reports.<sup>1-5</sup> The most recent pediatric case series published reviewed 13 cases of anaphylaxis; 6 were fatal, and 7 were near-fatal.<sup>1</sup> Because failure of prompt recognition and treatment of anaphylaxis can result

in death,<sup>1,6-8</sup> it is important to elucidate this process in children better. The purpose of the current investigation was to describe the epidemiology, treatment, and outcome of anaphylaxis in a large series of children.

## METHODS

We reviewed records of all patients younger than 19 years who, between January 1990 and December 1994, were admitted to the Children's Hospital of Philadelphia with a primary diagnosis of systemic anaphylaxis or received a complication diagnosis of anaphylaxis while hospitalized. We confirmed, by review of the records, the diagnostic impression of systemic anaphylaxis. This was defined as an acute reaction that occurred in response to an identified or unidentified antigenic agent and involved the respiratory and/or cardiovascular systems. At times this was accompanied by some combination of dermatologic, neurologic, and gastrointestinal symptoms. From each hospital record we collected demographic and epidemiologic data, pertinent medical history, symptoms and physical findings on presentation, prehospital and hospital treatment, course of illness, and outcome. Simple frequencies were calculated. Categorical variables were compared using  $\chi^2$  analysis.

## RESULTS

We identified 55 episodes of nonfatal anaphylaxis in 50 patients (Table 1). Five patients each had 2 reactions during the 5-year study period. Patients' ages ranged from 1 to 19 (median, 7) years. In the population studied, 56% were male, and 54% were African-American. Anaphylaxis occurred outside of the hospital in 58% of the cases (Table 2).

The most common site of occurrence was in the child's own home (45%). Ten types of inciting agents were identified (Table 3), including latex (27%), food (25%), medication (16%), and insect venom (15%). The foods implicated most frequently were nuts and peanuts (6 of 14) and seafood (4 of 14). The route of

**TABLE 1.** Patient Characteristics

| Characteristic               | n (%)   |
|------------------------------|---------|
| Age, y                       |         |
| 1-5 y                        | 23 (42) |
| 6-11 y                       | 14 (25) |
| 12-19 y                      | 18 (33) |
| Sex                          |         |
| M                            | 31 (56) |
| F                            | 24 (44) |
| Race                         |         |
| Black                        | 30 (54) |
| White                        | 22 (40) |
| Hispanic                     | 3 (6)   |
| Prior history                |         |
| Allergy                      | 30 (54) |
| Allergy to current agent     | 19 (35) |
| Anaphylaxis                  | 17 (31) |
| Anaphylaxis to current agent | 13 (21) |

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**TABLE 2.** Site of Occurrence

| Site                        | n (%)   |
|-----------------------------|---------|
| Home                        | 25 (45) |
| School                      | 2 (4)   |
| Other nonhospital           | 5 (9)   |
| In hospital, operating room | 8 (15)  |
| In hospital, other          | 15 (27) |
| Total                       | 55      |

**TABLE 3.** Anaphylactic Agents

| Agent           | n (%)   |
|-----------------|---------|
| Latex           | 15 (27) |
| Insect venom    | 8 (15)  |
| Unknown         | 7 (13)  |
| Nuts, peanuts   | 6 (11)  |
| Antibiotics     | 5 (9)   |
| Other drugs     | 4 (7)   |
| Shellfish, fish | 4 (7)   |
| Other food      | 4 (7)   |
| Radiocontrast   | 1 (2)   |
| Poison ivy      | 1 (2)   |
| Total           | 55      |

exposure to the agent was intravenous (IV) in 38% of the episodes (including 13 of 15 cases of latex anaphylaxis), oral in 27%, and transcutaneous or subcutaneous in 20% (including 2 cases of latex anaphylaxis) (Table 4). In the five patients who had two reactions, latex was the causative agent for four individuals, and peanuts were the causative agents for the other. IV latex exposure followed the use of non-latex-free IV injection materials (IV tubing and ports), whereas transdermal latex exposure involved skin and/or mucous membrane contact with latex gloves.

The most frequent initial manifestations of the reactions are shown in Table 5. Dermatologic signs and symptoms were the most common (60%); urticaria were seen in 17 of 55 patients. Also seen were erythema (6 of 55), face or lip swelling (6 of 55), extremity edema (1 of 55), pruritis (2 of 55), and other rashes (1 of 55). Respiratory abnormalities were the second most often observed initial signs and symptoms. We defined lower-airway involvement as wheezing and upper-airway involvement as tongue swelling, oral mucosa swelling, throat discomfort, dysphagia, hoarseness, and stridor. Undifferentiated respiratory symptoms were considered dyspnea, cough, or cyanosis. The most common were difficulty breathing ( $n = 6$ ), tongue swelling ( $n = 3$ ), wheezing ( $n = 2$ ), cough ( $n = 2$ ), and throat swelling ( $n = 1$ ). Gastrointestinal (nausea, vomiting, and abdominal pain), neurologic (aura, irritability, lethargy, disorientation, dizziness, tremor, syncope, and seizure), and cardio-

**TABLE 4.** Route of Exposure

| Route          | n (%)   |
|----------------|---------|
| Intravenous    | 21 (38) |
| Oral           | 15 (27) |
| Subcutaneous   | 8 (15)  |
| Transcutaneous | 3 (5)   |
| Inhaled        | 1 (2)   |
| Unknown        | 7 (13)  |
| Total          | 55      |

**TABLE 5.** Organ System Involvement

| System                                 | n (%)   |
|----------------------------------------|---------|
| Initial presenting signs and symptoms: |         |
| Dermatologic                           | 33 (60) |
| Respiratory                            | 14 (25) |
| Gastrointestinal                       | 3 (5)   |
| Neurologic                             | 2 (4)   |
| Cardiovascular                         | 1 (2)   |
| Other                                  | 2 (4)   |
| Overall signs and symptoms             |         |
| Dermatologic                           | 51 (93) |
| Respiratory                            | 51 (93) |
| Cardiovascular                         | 14 (26) |
| Neurologic                             | 14 (26) |
| Gastrointestinal                       | 7 (13)  |

vascular (hypotension, hypoperfusion, tachycardia, bradycardia, and asystole) initial manifestations were much less common (2% to 5%).

During the entire course of their illnesses, 93% of patients had respiratory symptoms, and 93% had dermatologic symptoms (Table 5). Cardiovascular and neurologic manifestations were less frequently present (26% each). Gastrointestinal manifestations were the least common, affecting only 13% of patients. Of the 7 patients with gastrointestinal symptoms, 3 had histories of food allergies and were currently reacting to food items. A review of the 16 patients with food allergies revealed that 10 were currently reacting to food, and 3 of those had gastrointestinal involvement.

The medical treatment of the patients in our series varied. Of the total group of 55, 46 (84%) received epinephrine, 46 (84%) received steroids, 46 (84%) received an  $H_1$  blocker, 12 (22%) received an  $H_2$  blocker, and 22 (40%) received aerosolized bronchodilators. Only 4 patients required bronchodilator therapy for more than 1 day, and only 7 patients required more than two doses of epinephrine. Our patients were hospitalized for an average of 2 (mode, 1; range, 1 to 7) days. Eleven patients were managed in the intensive care unit (ICU).

We encountered no fatalities attributable to anaphylaxis. However, 11 patients required treatment in our ICU. Features distinguishing these 11 patients are listed in Table 6. In-hospital site of occurrence ( $P = .02$ ) and IV route of exposure ( $P = .01$ ) were more common in children requiring ICU treatment. Four other features showed less-striking, but observable, differences between the two groups. Latex as the inciting agent, no prior history of anaphylaxis, and cardiovascular involvement were more fre-

**TABLE 6.** Comparison of Intensive Care Unit (ICU) and Non-ICU Patients

|                              | ICU<br>( $n = 11$ ),<br>n (%) | Non-ICU<br>( $n = 44$ ),<br>n (%) | <i>P</i> |
|------------------------------|-------------------------------|-----------------------------------|----------|
| Site: in hospital            | 8 (73)                        | 15 (34)                           | .02      |
| Agent: latex                 | 5 (46)                        | 10 (23)                           | .13      |
| Route: intravenous           | 8 (73)                        | 13 (30)                           | .01      |
| Prior history of anaphylaxis | 2 (18)                        | 15 (34)                           | .26      |
| Cardiovascular symptoms      | 5 (45)                        | 9 (20)                            | .10      |
| Respiratory symptoms         | 9 (82)                        | 42 (95)                           | .17      |

quently seen in those patients requiring intensive care.

When comparing in-hospital and out-of-hospital sites of occurrence, several differences are notable (Table 7). Reactions occurring out of the hospital with identifiable agents were triggered by foods (n = 14), insect venom (n = 8), and oral medication (n = 2). In-hospital reactions, by contrast, were elicited by latex (n = 15), IV medications (n = 6), IV immunoglobulin (n = 1), and radiocontrast material (n = 1). Histories of food allergy, atopy, or asthma was reported more frequently by patients with out-of-hospital reactions, whereas histories of known drug allergies were reported more often in those with in-hospital anaphylactic reactions. Of the five dermatologic manifestations that we evaluated (pruritis, urticaria, facial edema, lip swelling, and tongue swelling), all were more common in the out-of-hospital group. The difference in the two groups with respect to pruritis and facial edema was statistically significantly different ( $P = .01$  for each).

In 17 of the 55 episodes, the patients had previously had at least one anaphylactic reaction (Table 8). The agents responsible for the current reaction in 13 of these cases were identical to the previously identified agents. Despite this known allergy history, epinephrine self-administration device availability was poor. Of the 9 patients who had their current reactions in out-of-hospital settings, only 5 (56%) had the devices available for use. Furthermore, they were successfully used in only 3 patients.

## DISCUSSION

We report the largest series of anaphylaxis in children. Our data confirm that anaphylaxis is a not-uncommon childhood emergency that most often occurs at home or in other out-of-hospital settings. Because of this, it is imperative that parents are educated to recognize the common presenting clinical manifestations of this disease readily. In our series, these were most often either dermatologic (60%) or respiratory (25%). Of the 55 children enrolled, 17 presented first with urticaria, and 6 presented with facial or lip swelling. In 8 children wheezing or difficulty breathing was the first abnormality noted. This trend continued for most children; dermatologic and/or respiratory symptoms developed in 93% of

**TABLE 8.** Patients with Prior Anaphylaxis

| Current Agent (n = 17) | In Hospital | Out of Hospital |
|------------------------|-------------|-----------------|
| Latex                  | 7           | 0               |
| Food                   | 0           | 5               |
| Venom                  | 0           | 2               |
| Drug                   | 1           | 0               |
| Unknown                | 0           | 2               |
| Total                  | 8           | 9               |

the children at some point during the course of their illness.

Although no general comparison data between children and adults for fatal and nonfatal anaphylactic reactions exist,<sup>9</sup> individual differences have been noted by others.<sup>6,8-11</sup> Our data substantiate several of these differences. One prior report<sup>10</sup> indicated that children react less frequently to radiocontrast material than adults. In our study, only one reaction in 5 years was caused by this agent. Similarly, the severity of reactions and death rate secondary to hymenoptera hypersensitivity is stated to be greater in adults.<sup>8</sup> Of the eight reactions caused by *Hymenoptera* venom in our series, none resulted in a fatal outcome. Finally, cardiovascular manifestations were less frequently manifested by children in our study population than they were in adults with anaphylaxis.<sup>6,11</sup>

The type of agent triggering anaphylaxis varies by setting. Anaphylaxis in inpatients most commonly follows exposure to drugs or latex. Food and insect venom most often cause anaphylaxis in nonhospitalized children. Although food and venom are well recognized causes of anaphylaxis,<sup>1-4,12,13</sup> the role of latex in this regard deserves emphasis.<sup>5,14</sup> Not only was latex the single most common causative agent in our study population, it was often overlooked in this role. In several cases of recurrent latex-related anaphylaxis, it was initially thought that parenterally administered antibiotics were the causative agents. After full evaluation of these patient reactions by allergy and immunology consultants and, at times, serologic testing, the diagnosis of latex hypersensitivity was made. Lack of appreciation of this association likely contributed to 13 anaphylactic reactions in our study population. The precise mechanism of how latex-related proteins become available for immunogenic reaction remains unclear. Latex is a com-

**TABLE 7.** Comparison of Out-of-hospital and In-hospital Patients

| Reaction Characteristic | Out of hospital (n = 32), n (%)                                         | In Hospital (n = 23), n (%)                                                              | P   |
|-------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------------------------|-----|
| Agents                  | Foods 14<br>Insect venom 8<br>Unknown 7<br>Oral meds 2<br>Plant resin 1 | Latex 15<br>Intravenous medications 6<br>Intravenous immunoglobulin 1<br>Radiocontrast 1 |     |
| Drug allergy history    | 3 (9)                                                                   | 9 (39)                                                                                   | .02 |
| Food allergy history    | 12 (37)                                                                 | 4 (17)                                                                                   | .18 |
| Atopy history           | 7 (22)                                                                  | 1 (5)                                                                                    | .07 |
| Asthma history          | 12 (38)                                                                 | 2 (9)                                                                                    | .01 |
| Dermatologic symptoms   |                                                                         |                                                                                          |     |
| Pruritis                | 20 (63)                                                                 | 6 (26)                                                                                   | .01 |
| Urticaria               | 22 (69)                                                                 | 10 (44)                                                                                  | .06 |
| Facial edema            | 27 (85)                                                                 | 12 (52)                                                                                  | .01 |
| Lip swelling            | 11 (34)                                                                 | 3 (13)                                                                                   | .07 |
| Tongue swelling         | 7 (22)                                                                  | 1 (4)                                                                                    | .07 |

plex biological mixture composed of rubber particles in a matrix containing multiple proteins. Latex-hypersensitive individuals, in general, show immunoglobulin E to multiple latex components on testing of their serum.

The greater frequency of latex causation might reflect the primary nature of our tertiary care center patient population and a potentially greater prevalence of conditions that predispose to multiple latex exposures and eventual latex hypersensitivity.<sup>5,8,14</sup> The 15 episodes of latex anaphylaxis occurred in 11 individuals. Four patients had 2 reactions each. All 11 had had multiple hospitalizations, and 10 had had multiple operations. Six patients had previously undergone ventriculoperitoneal shunt placement, 1 in association with myelomeningocele repair. Two cases involved congenital urologic malformations with multiple urologic operations, 2 had premature birth, and 1 had a history of imperforate anus. All of the above conditions are known to place patients at high risk for latex hypersensitivity.<sup>15</sup>

Comparison of anaphylactic reactions occurring in and out of the hospital revealed several distinguishing features. Oral and subcutaneous agents were seen exclusively in the out-of-hospital group, whereas IV agents were responsible for all but two of the in-hospital reactions. The former group also had a greater prevalence of food allergy, atopy, and asthma and also had more dermatologic manifestations during their reactions. This last finding might be artifactual. Eight of the in-hospital reactions occurred in patients undergoing general anesthesia, in which dermatologic symptoms would not have been reported by the patient, and dermatologic signs could have been obscured by surgical drapes.

Unanticipated reexposure to other causative agents occurred in a substantial number of our patients. Similar to previous reports,<sup>1,2,4</sup> many children in our series were unknowingly exposed to agents to which they had previously had anaphylactic reactions. For these children, it is imperative that home treatment be readily available. However, of the 9 children whose reactions occurred in nonhospital settings and who had had at least one prior episode of anaphylaxis, only 5 had epinephrine self-administration devices available for use, and only 3 used them. Of the 11 children with known food allergies who had reactions in nonhospital setting, 8 had known histories of asthma and, therefore, would be at risk for more severe reactions. Again, only 3 of these individuals had self-injectable epinephrine available for use, and in just 2 cases was it administered. This simple potentially life-saving measure must be better addressed in these patients.

Although histories of anaphylaxis were known in many of our patients, the majority of children (69%) had never before had the reaction. Twenty-two children within this group had no known allergies. Most of these tended to be young children; 21 were younger than 8 years. These trends are important for pediatricians to recognize, because they formulate the anticipatory guidance that they give to parents of young children and to appropriate school officials.<sup>16,17</sup>

Although our comparison groups are small, patients requiring intensive care were more likely to have had IV exposure to inciting agents while inpatients. Many of these children were exposed to the agents in the operating suite, where they were attended to by physicians who preferred to continue their postoperative treatment in an ICU setting. Although not statistically significantly different, there was a trend toward more common occurrence of cardiovascular symptoms in patients requiring intensive care. Overall, cardiovascular symptoms are less common (26%) than dermatologic or respiratory symptoms.

One striking difference between our case series and that reported by Sampson et al<sup>1</sup> is a lack of fatalities in our group. The most notable difference between the two groups would seem to be the prevalence of asthma: 100% in their fatal outcomes compared with 14% of our nonfatal series. The higher prevalence of asthma in their patients may have played a role in the higher mortality. Also, all 6 of their patients with tragic outcomes had known food allergies. In our population, only 71% of those who had anaphylaxis as a result of food had known histories of food allergies. Although there was no difference in the average time to onset of epinephrine administration (93 vs 96 minutes) in the two study groups, there was a marked difference in the mean time to onset of symptoms after antigen exposure (19 minutes in the fatal cases of Sampson et al<sup>1</sup> and 59 minutes in our nonfatal cases). Location at the time of the reaction also differs between groups. All but 1 of the fatal reactions occurred away from home. Twelve of the 14 cases of food anaphylaxis in our study occurred at home or in the homes of relatives. This supports the theory proposed previously<sup>1</sup> that it may be easier to respond to a reaction at home than in a public setting.

Because our facility is one of two pediatric referral centers in the greater Philadelphia area, and the pre-hospital care system here calls for transport of critically ill children to one of these two centers, we are confident that the more serious reactions were well represented at our center.

## Conclusions

We conclude that anaphylaxis is a disease that affects children with some regularity. The initial symptoms are generally dermatologic or respiratory in nature. Most affected children have no stated histories of prior reaction to the causative agents. Severely ill children more commonly have nonenteral or latex exposure. Children who have had past episodes of anaphylaxis infrequently have epinephrine self-administration devices available for use.

## REFERENCES

1. Sampson HA, Mendelson L, Rosen JP. Fatal and near-fatal anaphylactic reactions to food in children and adolescents. *N Engl J Med*. 1992;327:380-384
2. Yunginger JW, Sweeney KG, Sturmer WQ, et al. Fatal food-induced anaphylaxis. *JAMA* 1988;260:1450-1452
3. Arive BK. Multiple Africanized bee stings in a child. *Pediatrics*. 1994;94:115-117

4. Fries JH. Peanuts. Allergic and other untoward reactions. *Ann Allergy*. 1982;48:220–226
5. Gold M, Swartz JS, Braude BM, et al. Intraoperative anaphylaxis: an association with latex sensitivity. *J Allergy Clin Immunol*. 1991;87:662–666
6. Sullivan TJ III. Systemic anaphylaxis. In: Lichtenstein LM, Fauci AS, eds. *Current Therapy in Allergy, Immunology and Rheumatology*. Philadelphia, PA: BC Decker, Inc; 1988;3:91–98
7. Marquarat DL, Wasserman S. Anaphylaxis. In: Middleton E Jr, Reed CE, Ellis EF, et al, eds. *Allergy Principles and Practice*. St Louis, MO: CV Mosby; 1993;2:1525–1536
8. Saryan JA, O'Loughlin JM. Anaphylaxis in children. *Pediatr Ann*. 1992;21:590–598
9. Bochner BS, Lichtenstein LM. Anaphylaxis. *N Engl J Med* 1991;324:1785–1790
10. Yunginger JW. Anaphylaxis. *Ann Allergy*. 1992;69:87–95
11. Atkinson TP, Kalinger MA. Anaphylaxis. *Med Clin North Am*. 1992;76:841–855
12. Valentine MD. Anaphylaxis and stinging insect hypersensitivity. *JAMA*. 1992;268:2830–2833
13. Moffitt JE, Yates AB, Stafford CT. Allergy to insect stings. *Postgrad Med*. 1993;93:197–208
14. Kelly KJ, Pearson ML, Kurup VP, et al. A cluster of anaphylactic reactions in children with spina bifida during general anesthesia: epidemiologic features, risk factors, and latex hypersensitivity. *J Allergy Clin Immunol*. 1994;94:53–60
15. Landwehr LP, Boguniewicz M. Current perspectives on latex allergy. *J Pediatr*. 1996;128:305–312
16. Wynn SR, Frazier CA, Munoz-Furlong A, et al. Anaphylaxis at school: etiologic factors, prevalence and treatment. *Pediatrics*. 1993;91:516
17. Hay GH, Harper TB III, Courson FH. Preparing school personnel to assist students with life-threatening food allergies. *J Sch Health*. 1994;64:119–121

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