



Anaphylaxis in the community setting: determining risk factors for admission

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ARTICLE INFO

Article history:

Received for publication April 2, 2012.

Received in revised form May 20, 2012.

Accepted for publication June 1, 2012.

ABSTRACT

Background: Although the identification and management of anaphylaxis in an emergency department setting has been well studied, our understanding of the risk factors for admission in a community-based hospital is lacking.

Objective: To determine the demographics and the predictors of hospitalization, in patients presenting with anaphylaxis to a community-based emergency department (ED).

Methods: We performed a five-year retrospective chart review of all patients seen in the ED of Winthrop University Hospital, a community-based institution, with an *International Classification of Diseases, 9th Edition* code related to anaphylaxis.

Results: Fifty-eight visits met inclusion criteria, of which 34% resulted in hospital admission (95% CI: 22–48%). Univariate predictors for admission included (1) the involvement of 2, 3, and 4 organ systems (26%, 55%, and 75%, respectively; $P < .02$); (2) gastrointestinal symptoms vs no symptoms (59% vs 24%, $P < .02$); (3) non-sting (ingested and other allergens) vs insect sting allergen (50% vs 12.5%, $P < .005$); and (4) a history of an ED visit for anaphylaxis vs none (67% vs 30%, $P < .05$). Multivariate analysis (logistic regression) confirmed non-sting allergens ($p < 0.02$) and number of organ systems involved ($P < .05$) as independent predictors of hospitalization.

Conclusion: In our study population, the involvement of multiple organ systems, particularly gastrointestinal involvement, a history of ED visits for anaphylaxis, and involvement of ingested or other allergens (non-sting) demonstrated higher admission rates.

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Introduction

The prevalence of anaphylaxis in the United States is reaching upper estimates of 2%, and hospitalizations for patients presenting with severe allergic reactions are increasing internationally.^{1,2} While anaphylaxis rates continue to rise, there are no existing consensus guidelines on when to hospitalize patients; there also are few data on risk factors associated with hospital admission. Recent studies have begun to fill this void,^{3–5} such as a multicenter review of hospital admissions for food-related allergic reactions.³ In a review of food allergy, factors associated with a higher likelihood of hospital admission included pre-emergency department (ED) epinephrine treatment, and epinephrine treatment within 1 hour of ED triage, whereas negative predictors included patients with shellfish allergy. These data are critical in identifying patients who will benefit from extended observation after anaphylaxis;

however, the identification of more risk factors for hospitalization is still needed.

The Anaphylaxis Working Group of the American College of Asthma, Allergy and Immunology established that a lack of geographic-based population studies on the subject.⁶ Hospital admission rates for anaphylaxis vary depending on whether a patient is seen at a large tertiary care network such as the Mayo Clinic⁷—with admission rates at 7%—or a specialty network such as the Children's Hospital of Alabama⁸ with admission rates of 27%. A survey of the literature on anaphylaxis and hospital admissions demonstrates both a prevalence of large multicenter studies involving regional and national surveys, and studies specific to certain allergic triggers. There is a gap in our knowledge about risk factors for admission in a community-based hospital for patients presenting with anaphylaxis.

Our objective was to study the demographics and determine the independent predictors of hospitalization in this population. Data gathered from such studies may help form future guidelines for admission and address the regional variability seen in admission rates between medical centers.

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Disclosures: Authors have nothing to disclose.

Table 1
ICD-9 codes used for anaphylaxis

ICD-9 code	Description	Number of cases
287.0	Allergic purpura	0
977	Poisoning by other and unspecified drugs	0
989.5	Toxic effect of venom	24
995.0	Other anaphylactic shock NEC	23
995.1	Angioneurotic edema	0
995.27	Other drug allergy	0
995.3	Allergy unspecified	0
995.60-.69	Anaphylactic shock due to food reaction	11
995.7	Other adverse food reaction	0

Methods

Study design

Medical records were reviewed at our hospital, a 591-bed institution seeing approximately 59,000 patients in the ED annually. We conducted a 5-year retrospective chart review of all patients seen between August 2005 and March 2010 admitted to our ED, with an *International Classification of Diseases, 9th Edition* (ICD-9) code for anaphylaxis (Table 1). This review was approved by our institutional review board as an exempt study.

Inclusion criteria

Our inclusion criteria for the study were (Table 2): (1) patients seen in the ED with an anaphylaxis-related ICD-9 code: 995.0 (other anaphylactic shock not elsewhere classified), 995.1 (angioneurotic edema), 995.60–69 (anaphylactic shock due to food reaction), 995.27 (other drug allergy), 995.3 (allergy unspecified), 995.7 (other adverse food reactions), 989.5 (toxic effect of venom), 977 (poisoning by other and unspecified drug), 287.0 (allergic purpura), and (2) cases that met the clinical definition of anaphylaxis as described in the National Institute of Allergy and Infectious Diseases/Food Allergy and Anaphylaxis Network Second Symposium on the Definition and Management of Anaphylaxis.⁹ Subjects were excluded if on chart review the visits were not allergy related (either 977 or 287.0 with no other codes), or did not meet the clinical criteria of anaphylaxis.

Definitions

The chosen ICD-9 codes were a consensus between the Allergy-Immunology Department and the ED at Winthrop and include the codes used by our emergency physicians for allergy- and anaphylaxis-related diagnoses. In addition to the ICD-9 codes, we used a clinical definition of anaphylaxis commonly used by physicians as a point of reference from the “Second Symposium on the Definition and Management of Anaphylaxis.”⁹ Anaphylaxis is said to be highly likely when any 1 of 3 criteria are met: (1) Acute onset of an illness (minutes to several hours) with involvement of the skin, mucosal tissue, or both and at least 1 of the following; respiratory compromise, and reduced blood pressure or associated symptoms; (2) Two or more of the following that occur rapidly after exposure to a likely allergen: involvement of the skin–mucosal tissue, respiratory compromise, reduced blood pressure or associated symptoms, and per-

Table 2
Summary of cases meeting study criteria

Criteria	Number of cases
Cases matched ICD-9 codes	794
Excluded for non-allergic visits	311
Excluded for not meeting anaphylaxis criteria	425
Cases that met both ICD-9 and anaphylaxis inclusion criteria	58
Included cases with non-sting allergens	34
Included cases with sting allergens	24

Table 3
Demographics of study population

Category	%	%
Age (mean, 31.5 years)	Adult: 55 (n = 32)	Pediatric: 45 (n = 26)
Sex	Male: 53 (n = 31)	Female: 47 (n = 27)
Admission status	Not admitted: 66 (n = 38)	Admitted: 34 (n = 20)
Allergen type	Non-sting: 59 (n = 34)	Ingested & other: 41 (n = 24)

sistent gastrointestinal (GI) symptoms. (3) Reduced blood pressure after exposure to a known allergen for that patient; infants and children defined as an age-specific low systolic blood pressure or greater than 30% decrease in systolic blood pressure, adults defined as a systolic blood pressure less than 90 mmHg or greater than 30% decrease in that person's baseline.

Data Collection

Charts that met our inclusion criteria were examined to determine descriptive demographics and independent predictors of hospitalization. Data collected included: age, sex, allergen type, history of asthma, prior ED visit for anaphylaxis (this can be better documented than a history of anaphylaxis, verifiable as physician-diagnosed rather than self-diagnosed, and implies a more severe reaction), transport by emergency medical services, epinephrine administration (prehospital and in the ED), cardiovascular compromise, respiratory symptoms, GI involvement, late phase response (recurrence of symptoms in <72 hours), serum tryptase level, prescription for epinephrine upon discharge, and referral to an allergist.

Statistical Analysis

Univariate analysis was performed to determine all possible predictors for hospitalization. Continuous predictors (eg, age) were evaluated by the rank-sum test. For categorical variables (eg, sex, number of organ symptoms involved), we used the Fisher's exact test or the χ^2 test for trend. The univariate analysis was also used to find significant predictors, which were then used as candidates for the multivariate analysis (ie, stepwise multiple logistic regression) where a series of independent variables (predictors) were used to predict a binary variable (whether or not hospitalized). All calculations were performed using SAS 9.2 for Windows (SAS Institute, Inc., Cary, NC); results were considered significant when $P < .05$.

Results

Between August 2005 and March 2010, 794 patients were seen in the ED with an anaphylaxis-related ICD-9 code. Of those charts, 311 were excluded for nonallergic visits (eg, drug overdose coded as 977 ICD-9 code), and 425 charts were excluded for not meeting the clinical definition of anaphylaxis. Fifty-eight charts thus met inclusion criteria for the study and were reviewed for data collection (Table 2).

Demographics

Key descriptive demographics of the study populations included age distribution (median age, 27 years; mean, 31.5; range, 2–83; standard deviation, 23.0), with 55% adult and 45% pediatric (age <21 years) patients, 47% female and 53% male, and a hospital admission rate of 34% (Table 3).

Clinical presentation

Of the 58 patients meeting the inclusion criteria for our study; 41% of ED visits were for insect sting vs 59% from ingested and other allergens (24 patients venom, 23 patients other anaphylactic shock NEC, and 11 patients food). Most of the latter category was likely secondary to food allergens; however, lack of specific documentation and concurrent home medication administration led to this more general classification.

Table 4
Hospitalization rates by predictor

Predictor	%	%	P Value
Gender	Male: 32	Female: 37	.79
Age	Pediatric: 37	Adult: 34	.99
Allergen	Sting: 12.5	Ingested and other: 50	<.005
Prior ED visit for anaphylaxis	No: 30	Yes: 67	<.05
Asthma history	No: 29	Yes: 42	.49
Transport by EMS	No: 30	Yes: 31	.99
Prehospital epinephrine	No: 35	Yes: 30	.99
Epinephrine (ED)	No: 35	Yes: 33	.99
Cardiovascular symptoms	No: 33	Yes: 40	.75
Respiratory symptoms	No: 31	Yes: 36	.99
Gastrointestinal symptoms	No: 24	Yes: 59	<.02

Predictors of hospitalization

The organ system involved most predictive of hospital admission was the presence of GI symptoms (Table 4); admission rates for those patients with GI involvement vs no GI involvement was 59% vs 24% ($P < .02$). Anaphylaxis from ingested and other allergens had a higher admission rate than anaphylaxis after an insect sting (50% vs 12.5%; $P < .005$). Those individuals with a previous ED visit for anaphylaxis had an admission rate more than double that of those patients without a history of a systemic allergic reaction (67% vs 30%; $P < .05$). Interestingly, factors such as age, sex, cardiovascular compromise, airway involvement, history of asthma, epinephrine use, and transport via emergency medical services were not associated with increased hospitalization rates. Data for 4 areas in our evaluation (late phase response, serum tryptase level, prescription for epinephrine on discharge, and referral to an allergist) were insufficient for analysis. The number of involved organ systems per patient correlated directly with rates for hospitalization (Fig 1); 2-organ-system involvement had an admission rate of 26%, 3 had an admission rate of 55%, and 4 had an admission rate of 75% ($P < .02$, trend test). Multivariate analysis (logistic regression) confirmed non-sting allergens ($P < .02$) and number of organ systems involved ($P < .05$) as independent predictors of hospitalization.

Discussion

Our study describes 58 visits to a community ED over a 5-year period for anaphylaxis, with special attention to key demographics and predictors of hospitalization. To our knowledge this is the first study examining independent risk factors for admission of anaphylaxis in a community setting, helping to fulfill the void established by the Anaphylaxis Working Group of the American College of Allergy, Allergy and Immunology for more geographic-based population studies.⁶

Although hospitalization rates for anaphylaxis have been shown to vary based on institution size,^{7,8} the paucity of studies in com-

munity EDs complicates comparison. However, our overall admission rate of 34% is in line with the 27% found in a similar health network.⁸ Many of these studies have focused solely on either pediatric or adult admissions; our institution parallels many community hospitals around the United States, treating both adult and pediatric patient ED visits.

In regard to the demographics of our population, we demonstrated a male to female predominance of 53% to 47% and an adult to pediatric ratio of 55% to 45%. Both of these factors were not predictive of hospitalization in our study. However, other studies looking at predictors of hospitalization have found age to be a determinant for admission.¹⁰ One study¹¹ from 2001 examining hospitalization rates for anaphylaxis in 464 patients in Florida (from a statewide database) found that patients younger than 18 years of age are 3 times more likely to be hospitalized for food-related anaphylaxis than patients aged 71 years and older.

This same study¹¹ found a history of asthma to be predictive of hospitalization for anaphylaxis. In cases of food-related anaphylaxis, patients with asthma have been suggested to be at higher risk for a fatal episode.¹² Although our study data for hospitalization rates for patients with asthma vs patients without asthma did not reach statistical significance ($P = .49$), those patients with an asthma history had an admission rate of 42% vs. 29% in those with no asthma. Patients receiving epinephrine have also been shown to have improved outcomes, and although our data for epinephrine use did not reach statistical significance ($P = .99$), the 9 patients receiving epinephrine (3 by self-administration or emergency medical services, and 6 in the ED—all receiving 1 documented dose) showed similar overall admission rates to those that did not receive epinephrine (ED administration of epinephrine 33% vs no epinephrine 35%, and prehospital administration of epinephrine 30% vs no epinephrine 35%). Because of the single-institution nature of our study, the power was limited, and these demographics may have otherwise been significant. Another recent study examining admission risk factors for food-related anaphylaxis noted that although patients with a history of asthma are more likely admitted, asthma is not a predictor for hospitalization.³ Differences between these studies and our own data highlight the difficulty in drawing broad generalizations from large multicenter studies and applying them to the community setting.

When examining our predictors of hospital admission, our data demonstrated a direct relationship between the number of involved organ systems and hospital admission rates (2, 3, and 4 organ systems had admission rates of 26%, 55%, and 75%, respectively). In particular, the presence of GI symptoms in patients with anaphylaxis was a predictor of hospitalization; other predictors were patients who had a history of anaphylaxis and patients with an ingested or other allergen.

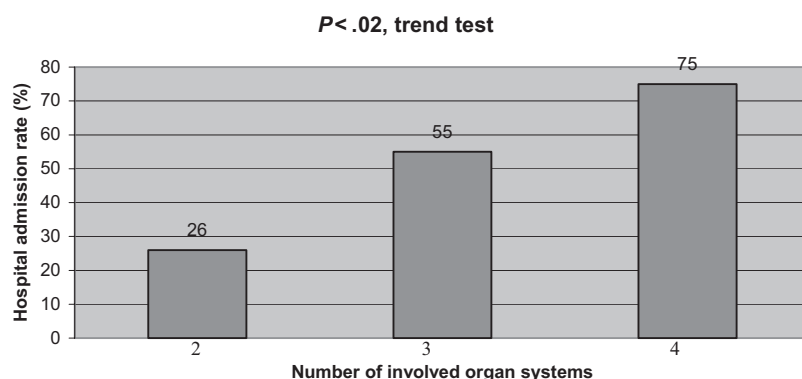


Fig. 1. Hospital admission rates increase when more organ systems are involved in presentation of the patient with anaphylaxis.

Although our goal was to look at risk factors for admission in a community setting; the study's single-institution nature did limit the power of our study, as did potentially missed cases of anaphylaxis attributable to ICD-9 miscoding. The retrospective examination also limited our data collection (eg, broader category classifications such as sting vs ingested and other allergen). Serum tryptase levels would also have added laboratory support to our clinical diagnoses of anaphylaxis but was not obtained by the ED staff in the 58 patients examined.

Our results parallel previous studies, which showed higher hospitalization rates for food-induced anaphylaxis when compared with insect sting-induced anaphylaxis³ and an overall increase in hospitalizations for food-related anaphylaxis.¹³ This may be related to an increase in GI symptoms and more extensive organ involvement, or an increased susceptibility for GI symptoms in patients with food-induced anaphylaxis. Based on our findings, we would recommend that physicians maintain a low threshold for admission in patients presenting with our risk factors for admission: specifically, a patient presenting with an anaphylactic episode involving multiple organ systems including GI symptoms after an exposure to an ingested allergen and a history of anaphylaxis.

Acknowledgments

We thank Martin Feuerman, MS, Biostatistician from Winthrop-University Hospital, for his expert assistance in data interpretation and statistical analysis.

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