The diagnosis and management of children presenting with anaphylaxis to a metropolitan Emergency Department: A two year retrospective case series.

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Abstract

Aim

To investigate the diagnosis and management of children with anaphylaxis presenting to an Emergency Department (ED). We compared the management with the Australasian Society of Clinical Immunology and Allergy (ASCIA) guidelines to gauge compliance.

Methods

A retrospective case series was developed from children aged from birth to 16 years presenting to the ED at Sunshine Hospital (SH) in Melbourne, Australia over a two-year period from January 1, 2012 to December 31, 2013. The demographic characteristics, causative agents, clinical features, treatment administered and discharge destination were recorded.

Results

Fifty-five children diagnosed with anaphylaxis during the two-year period were identified. Fifty-two children (95%) met the ASCIA diagnostic criteria, 49 (94%) children received adrenaline. The median age of presentation was five years, with males predominating (32[62%]). The most common setting was home (35 [67%]), and food (39 [75%]) was the most common causative agent. Cutaneous symptoms (50 [96%]) were the most prevalent. Twenty-eight (54%) children received adrenaline prior to arrival in ED whilst 22 (40%) received adrenaline in the ED. Thirty-three (63%) children were discharged home.

Conclusion

Childhood anaphylaxis commonly presents to the ED. More than half of children presenting with anaphylaxis were treated prior to attending the ED. The findings demonstrate that anaphylaxis diagnosis and management guidelines are being adhered to in the majority of cases. There were no adverse outcomes recorded.

What is already known on this topic?

1. The incidence of anaphylaxis has risen significantly throughout the developed world.
2. Food (especially nuts) is the most common trigger of anaphylaxis.
3. The ED is a common setting of anaphylaxis presentations for first time and subsequent reactions.

What this paper adds

1. The ASCIA diagnostic and management guidelines are largely being adhered to.
2. Anaphylaxis is often treated in the pre-hospital context.
3. Education and training regarding anaphylaxis must include the pre-hospital phase, with an emphasis on recognition of symptoms and signs.

Introduction

Anaphylaxis is a life-threatening illness with an estimated lifetime prevalence of 0.05-2%.[1] Studies have demonstrated that the incidence of allergic disease is rising in our community as part of a general increase in the developed world.[2-4] There is limited data exploring emergency department (ED) management in Australia. There is no universally agreed upon definition of, or clinical criteria for, anaphylaxis.[2] As this study was performed in an Australian ED, the definition, diagnostic criteria and management as outlined by the Australasian Society of Clinical Immunology and Allergy (ASCIA)[5] have been used.

The aim of this study was to investigate the diagnosis and management of children presenting to an ED with anaphylaxis, and compare the ED management to the standards of the ASCIA guidelines. Adrenaline is the first line management with early and prompt administration of parenteral adrenaline recommended.[5]

This study took place in ED at Sunshine Hospital (SH) in Melbourne, Victoria. This is one of three hospitals in the western suburbs of Melbourne, which comprise Western Health. SH ED services a culturally diverse population of 800 000 and is one of the fastest growing regions in Australia. The SH ED manages both adults and children with approximately 60 000 attendances per year. Approximately one-third of presentations are for children aged under 17.

Methods

Children with a discharge diagnosis of anaphylaxis, aged between 0 and 16 years, who presented to SH ED between January 1, 2012 and 31 December 2013 (inclusive) were eligible for this study. A specific, retrospective audit with a clinical report form (CRF) was developed for this study.

During each ED presentation, clinical information was collected and recorded by medical staff. Once a diagnosis was given, each patient file was scanned into the electronic medical record and an International Classification of Disease (ICD) code assigned by a trained medical clerk. The International Classification of Disease (ICD), maintained by the World Health Organisation (WHO) was used to identify cases. The version used was ICD-10-CM. Subjects for this study were identified by accessing 12 ICD-10-CM codes that included anaphylactic shock and generalised urticaria. The ICD codes for urticaria were included to enable the investigators to assess the patients presenting with generalised allergic disease for signs and symptoms of anaphylaxis as outlined in the ASCIA guidelines. A complete list of ICD-10-CM codes included in the analysis is documented in Table 1. Patients who either met the criteria or were classified as having anaphylaxis by the treating ED doctor were included in the study results. Patients with asthma presenting to the ED were not included in the search strategy within the ICD-10-CM codes as the department manages approximately 1000 cases of asthma per annum. A child with anaphylaxis, possibly miscoded as "asthma" would be difficult to identify within that number of patients.

The ASCIA definition utilised in this study states that anaphylaxis is "any acute onset illness with typical skin features (urticarial rash or erythema/flushing, and/or angioedema), PLUS involvement of respiratory and/or cardiovascular and/or persistent severe gastrointestinal symptoms or any acute onset of hypotension or bronchospasm or upper airway obstruction where anaphylaxis is considered possible, even if typical skin features are not present."[5]

For each patient, all available data was reviewed including: ambulance records, nursing notes, medical admission notes and observation charts. Data was collected and entered into a Microsoft Excel® spreadsheet (Microsoft corp, Seattle, USA). The details included: age, gender, language spoken at home, setting and perceived cause of reaction, mode of transport to hospital and discharge destination. For a patient to be classified as "admitted" a period of 4 hours or more in the ED or in the children's ward was used. Parent reported atopic history was also recorded. Signs and symptoms, ED diagnosis and management administered were recorded and then compared with the clinical guidelines.

The primary outcome was to determine if management of anaphylaxis in children presenting to the SH ED matched the ASCIA guidelines. We also aimed to examine the effectiveness of clinical diagnosis and management of children presenting with anaphylaxis to an Australian metropolitan ED.

Data was analysed using SPSS software version 22.0 and Analyse-it version 2.22 for Microsoft Excel®. Continuous data was expressed as either median or mean. A chi-square analysis and Fisher's Exact test was utilised to describe differences between groups with categorical values with p-values <0.05 considered statistically significant.

Ethics approval was obtained from the Western Health Human Research Ethics Committee prior to commencement of the study.

Results

Overview

Five hundred and fifteen (515) patient files were available for review utilising the 12 ICD codes. Of these, 55 were classified as anaphylaxis and 460 as urticaria. Of the 55 children classified as having anaphylaxis, 52 (95%) met the ASCIA criteria. Forty nine children received IM adrenaline either before or during treatment in ED. None of the children classified as having urticaria met the criteria for anaphylaxis.

Three (2 male; 1 female) children, aged six months, two years and ten years respectively did not meet the ASCIA criteria for anaphylaxis when reviewed, despite an ED discharge diagnosis of anaphylaxis. The causes of allergic reaction included egg, tree nut and a guinea pig. Cutaneous features were recorded in all three patients, with vomiting occurring in two. All were administered adrenaline prior to arriving in ED with no adverse outcomes.

The total attendance to Sunshine ED by children aged 0 to 16 years during the study period was 38 273. This gives a prevalence of 0.14% for children diagnosed with anaphylaxis.

Age, gender and language

Fifty-two (52) children were diagnosed with anaphylaxis (32[62%] males and 20[38%] females). The median age was five (range 2 months to 16 years) (Table 2). Fifty-one children spoke English at home and one spoke Vietnamese.

Allergic disease

Parents reported the presence of an atopic disease in 32 children (62%). Eighteen children (35%) specified a past diagnosis of asthma. Twenty children (36%) had a past history of anaphylaxis, however in the two-year study period, this was their first presentation to SH ED. No data was available to indicate when and where the past anaphylactic reactions occurred.**Setting and causative agents**

Reactions occurred at home most frequently (35 children, 67%), followed by reactions that occurred in an education setting (6 children, 11%). Thirty-three children (60%) arrived by ambulance. Five of these children had initially presented to a General Practice clinic where an ambulance was then called.

Food was the most common trigger (75%) for anaphylaxis with tree nuts accounting for 29% of all food causes (Table 3). There was no statistical significance found between any age group and having a food allergen. Allergic triggers for children presenting with a reaction at home included tree nut (10, 28%), unspecified food (7, 19%), peanut (4, 12%), egg (3, 8%), cow's milk (3, 8%), drugs (3, 8%), fish (1, 3%). The 15 tree nut

reactions were to pistachio (6, 38%), cashew (5, 33%), walnut (3, 18%) and sesame (1, 6%). Five children (14%) had anaphylaxis at home without an identifiable trigger.

The three drug reactions all occurred at home with beta-lactams, two with cephalexin and one with amoxicillin. Seven children (13%) had anaphylactic reactions of an unidentified cause whilst 12 (23%) had a reaction to an unknown ingredient in a food source. The two insect sting reactions were from bees..

Clinical Features

Cutaneous features were the most prevalent, occurring in 50 children (96%); followed by respiratory symptoms in 49 (89%) (Table 4). Wheeze was the most common respiratory feature, occurring in 26 children. The most frequent clinical feature combination was respiratory together with cutaneous features (46 children) while the most uncommon combination was cardiovascular without respiratory (three children). The causative agents for these three children was unspecified food (two children), and cephalexin (one child). No child presented with cardiovascular without cutaneous features. All children who presented with food anaphylaxis had the presence of cutaneous or gastrointestinal features associated with either respiratory and/or cardiovascular features.

Treatment prior to ED

Thirty-two children (62%) received treatment prior to presentation to SH ED of whom 12 had a past history of anaphylaxis (38%). The most common medication administered was IM adrenaline in 28 children (87%). Adrenaline was administered by the following people: 18 (61%) by an ambulance officer, six (23%) by a parent, three (10%) by a GP and one (4%) at another hospital. No IV adrenaline was administered by an ambulance

officer. Of the 12 children with a past history of anaphylaxis, 12 received IM adrenaline. Of the 28 treated with adrenaline prior to arrival in ED, one patient was given another dose of adrenaline in the ED. No data was available to provide detail on the sequence of treatment prior to ED.

Adjuvant therapy administered prior to ED included: one child being administered IV dexamethasone, four nebulised salbutamol, one IM promethazine, one ipratropium bromide. 12 children received an anti-histamine, one administered by a school nurse and 11 by a parent. One child was administered prochlorperazine by a GP.

Treatment administered in ED

Twenty-two children were treated in the ED with one dose of adrenaline, and all were administered via an intramuscular route (Table 5). Nine children (17%) were given a second dose of adrenaline and one (2%) was given a third dose. One of the second doses of adrenaline was nebulised. Three children were not given adrenaline either prior to, or during their time in hospital. The sequence of treatment recorded demonstrated that adrenaline was administered first in 18 children whilst 4 children received other therapy prior to adrenaline (2 prednisolone, 2 cetirizine).

There were no statistically significant characteristics in children who received more than one dose of adrenaline. Treatment with salbutamol was not statistically more common in children with a past history of asthma, when compared to patients without a past history of asthma.

Discharge destination

Thirty-three (63%) children were discharged home, 18 (34%) admitted and 1 (2%) transferred to the local tertiary centre after multiple doses of adrenaline were required. Fourteen children (42%) who were discharged home were given a referral to an allergy clinic and 8 children (15%) were given a prescription for an EpiPen junior. Four of these children had an unknown trigger and were classified as being discharged to an allergy clinic. Children administered a second dose of adrenaline were more likely to be

admitted to the ward (p=0.003). There were no fatalities recorded during the study period.

The child transferred to the Royal Children's Hospital was a 6 year old girl with a past history of anaphylaxis who had a reaction to cow's milk at home. An EpiPen was administered by her mother prior to arrival in ED with a further 2 adrenaline doses administered, the first via IM and the second nebulised.

Discussion

To our knowledge, this is the first study of anaphylaxis conducted in an outer metropolitan ED in Australia. The diagnostic criteria and management guidelines produced by the ASCIA were utilised throughout this paper and 95% of children in our cohort classified as having anaphylaxis met the ASCIA criteria. Furthermore 95% of children in our cohort were administered adrenaline either prior to arrival in ED or during admission, without an adverse event. One area of improvement needed is the long-term follow up provided to children in the ED context with 42% referred to an allergy clinic and eight being discharged with an EpiPen Junior in this study.

The incidence of anaphylaxis is increasing throughout the developed world[2,4]. Srivastava et al[6] suggested that a seven fold increase may have occurred in the last decade. The annual prevalence of anaphylaxis in children presenting to the ED of 0.14% is higher than in previous study findings,[7,8] including the first Australian ED study of children with anaphylaxis,[3] suggesting an incidence of 1 per 1000 presentations. The male predominance and domestic predominance of reactions, found in our cohort is comparable to other findings.[7,9]

The reporting of asthma was also similar to the cohort of de Silva[9] (32%) and Braganza (35%).[3] An inherent difficulty in these figures is reliance on parents accurately reporting the presence of atopic disease. Only 13% of patients had no documentation of their allergic disease. In children with a predominantly respiratory manifestation of

anaphylaxis, our study did not identify anaphylaxis masquerading as severe asthma as found by Rainbow[10] and Sargant et al[11], however, as this study excluded children presenting with asthma, these may have been missed.

Food, especially tree nut, was the most common causative agent. The overall food trigger findings correlate with both Australian[9] and international studies[8,12,13]; with some areas of difference. While de Silva[9] reported similar findings regarding the frequency of tree nut as an anaphylaxis trigger, our cohort had a much lower incidence of peanut associated anaphylaxis. The prevalence of tree nut allergens, particularly cashews, has been reported in the literature with some studies demonstrating an increasing trend in peanut allergens.[12,14,15] Our reported low number of peanut-triggered anaphylaxis may be due to the relative high number of mixed foods allegedly causing a reaction. Other studies parallel our findings for unspecified food and unidentified cause as triggers.[16,17] Braganza[3] reported egg and dairy triggers in 26% even though these were less common in our cohort. Of concern are the 12 patients with unspecified food and seven patients with an unidentified causative trigger as a source of allergen. In the majority of these cases, allergy clinic follow up was not provided. [9,17]

The clinical features observed in our study where cutaneous and respiratory features outweigh cardiovascular and gastrointestinal presentations is a finding consistent with several Australian and international studies.[3,4] We strongly relied on ambulance records for accurate clinical signs and symptoms in patients presenting to the ED post the administration of adrenaline.

Adrenaline is the accepted first line treatment for anaphylaxis.[5,18] The intramuscular (IM) route has been demonstrated to have a superior safety profile with a longer-lasting action than other routes of administration.[19] In our study, 95% of children received adrenaline either prior to, or during ED care, with all but one child receiving this via IM injection. Other studies[3,9,16,20] reveal a range in the frequency of adrenaline administration, varying from 26 to 85%.

We did not record the level of attending doctors, however, a recent simulation study of anaphylaxis demonstrated that junior doctors may require further training in the early

recognition and management of anaphylaxis.[21] Time to administration of adrenaline remains a concern with delay occurring in some patients.[3,9] Adjuvant therapy such as antihistamines and steroids remains frequent, with 42% of children being administered either of these medications during admission.[13]

Discharge to home or ward is the most likely outcome identified in the literature[3,9], and in our cohort. Adequate follow up for children with anaphylaxis remains a concern, particularly for children with unspecified food allergy or an unidentified cause as a trigger.[4,17,22]

The three patients who had signs and symptoms that did not meet the ASCIA criteria were all given adrenaline prior to presentation to ED. Cutaneous features were noted in all with gastrointestinal features in two patients. The causative agents were egg, tree nut and a guinea pig. Guinea pig is a known allergen in contact dermatitis, with cases of anaphylaxis reported.[23,24] Given that 62% of patients received care prior to ED admission, our findings suggest that more training for health clinicians in the pre-hospital context is required for the recognition of anaphylaxis according to the ASCIA guidelines[25]. No adverse outcomes occurred for these three patients.

We acknowledge there are limitations to this study. Medical record reviews have innate potential for error where data may be missing, inaccurate or have coding errors.[26] We were also unable to follow up patients. In addition, this single site study excluded the investigators from establishing if our patients with a documented past history of anaphylaxis had presented to another hospital during the study period.

Conclusion

The ASCIA guidelines for diagnosis and management are largely being adhered to in the SH ED. The prevalence of anaphylaxis at SH ED mirrors the rise in anaphylaxis reported elsewhere in the developed world, with our cohort having different triggers. Safe, effective and, for the most part, appropriate, treatment with adrenaline was provided. Three children did not meet the diagnostic criteria while another three were not administered adrenaline. The referral of children to an allergy clinic where indicated remains an area that requires improvement. Training of parents, GPs and ambulance

officers may assist in improving implementation of guidelines and it is recommended that all carers of children participate in the free ASCIA e-learning packages to increase education of anaphylaxis management.

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Tables

Table 1. ICD-10-CM discharge codes included in the study

Major category and code (brackets)
Anaphylactic shock due to adverse food reaction (T78.0)
Anaphylactic shock, unspecified (T78.2)
Anaphylactic shock due to adverse effect of correct drug or medicament properly administered (T88.6)
Allergic urticaria (L50.0)
Idiopathic urticaria (L50.1)
Urticaria due to cold and heat (L50.2)
Dermatographic urticaria (L50.3)
Vibratory urticaria (L50.4)
Cholinergic urticaria (L50.5)
Contact urticarial (L50.6)
Other urticarial (L50.8)

Table 2. Age and Gender (*n* = 52)

Age Range (years)	*n* (%)	Males	Females	Parent reported atopy	Past History of anaphylaxis
<1	3 (6)	3 (100)	0	2	0
1-5	25 (48)	21 (81)	4 (16)	19	9
6-11	16 (31)	5 (32)	11 (69)	8	6
12-16	8 (15)	3 (38)	5 (62)	2	5

Table 3. Causes of anaphylaxis (*n* = 52)

Allergen	*n* (%)	Median age (years)
A.		
Drugs	3 (5)	8 (2-9)
Food	39 (75)	3 (2 months - 16)
Insect Sting	2 (4)	10.5 (10-11)
Unidentified cause	8 (15)	5 (2-14)*

Food (*n* = 42)	*n* (%)
B.	
Cow's Milk	3 (8)
Soy Milk	1 (2)
Egg	2 (6)
Peanut	4 (10)
Tree nut	15 (39)
Fish	1 (2)
Shellfish	1 (2)
Not specified	12 (31)

*range in years

Table 4. Clinical features of children presenting with anaphylaxis (*n* = 52)

Clinical Feature	*n* (%)
A.	
Respiratory	49 (89)
Difficulty/noisy breathing	14 (26)
Shortness of breath	15 (27)
Stridor	3 (6)
Chest tightness	3 (6)
Wheeze	26 (47)
Cough	15 (27)
Swelling tongue	6 (11)
Swelling/tightness in throat	14 (26)
Difficulty talking/hoarseness	9 (16)
Cardiovascular	19 (35)
Hypotension	7 (13)
Pale and floppy (in young children)	1 (2)
Pallor	2 (4)
Mottled periphery	2 (4)
Impaired/Loss of consciousness	3 (6)
Tachycardia	8 (15)
Skin	50 (96)
Urticaria	48 (93)
Angioedema	17 (36)
Pruritis	43 (84)
Periorbital Swelling	5 (9)

Gastrointestinal	19 (35)
Vomiting	16 (29)
Abdominal cramps	5 (9)
Nausea	2 (4)
Clinical Feature Combination	
Respiratory without CVS	33
plus skin alone	46
plus GIT alone	18
and skin and GIT	16
CVS without Respiratory	3
and skin alone	0
and GIT alone	6
and skin and GIT	5
CVS with respiratory	15
and skin alone	14
and GIT alone	6
and skin and GIT	5

Table 5. Treatment administered prior to and during ED(*n* = 52).

Treatment prior to ED	*n* (%)	
Total number who received treatment prior	32 (62)	
Adrenaline prior	28 (88)	
Intramuscular	28 (100)	
Antihistamine	14 (44)	
Nebulised salbutamol	4 (9)	
Steroid	2 (6)	
Ipratropium bromide	1 (3)	
Treatment in ED	*n* (%)	**Median time to administration from arrival in ED(mins)**
Total number who had adrenaline	22 (40)*	
Adrenaline (1st)	22 (40)	28 (1 - 105)
Intramuscular	22 (100)	
Adrenaline (2nd)	9 (16)	45 (12 - 290)
Adrenaline (3rd)	1 (2)	240
Corticosteroids	23 (42)	47 (5 - 223)

Anti-histamine	23 (42)	50 (10 - 370)
Other therapy**	14 (25)	
Bolus normal saline	1 (2)	
Inhaled salbumatol	4 (7)	
Monitor only	1 (2)	
Total patients who received adrenaline	49 (94)	

*one patient treated prior to ED was administered one further dose of adrenaline in ED

**included paracetamol, ibuprofen, ondansetron, ipratropium bromide and ranitidine.

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