

Anaphylaxis audit in a busy metropolitan Emergency Department: a review of real life management compared to best practice

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Background: Deficiencies in anaphylaxis management in Emergency Departments is well recognised despite established guidelines for its treatment.

Objective: To identify deficiencies in the management of anaphylaxis in a busy metropolitan Emergency Department and determine if an education intervention could correct these.

Methods: Paediatric and adult admissions to the Emergency Department of a busy hospital were tracked over a 10-month period with a targeted educational program being instituted at 5 months. The electronic records were retrospectively reviewed looking for cases of anaphylaxis and milder forms of immediate type allergic reactions presenting with a combination of urticaria and nonairway threatening angioedema. Anaphylaxis presentation was graded using the Brown grading system. Use of all medication during resuscitation was documented. Observation period before discharge and referral to specialist unit for follow-up was noted.

Results: In the first 5 months, 38 patients fulfilled our criteria. Three had severe anaphylaxis, 13 had moderately severe anaphylaxis and 12 had urticaria and angioedema without anaphylaxis. Anaphylaxis was not always recognised or graded leading to inappropriate management with adrenaline often being withheld. Promethazine, usually given in parenteral form, was frequently administered. Observation time was often inadequate. Referral to an immunologist was not universally followed through. Following the educational intervention 58 patients fulfilled our criteria over the next 5 months. The appropriate use of adrenaline increased by 21% and the use of sedating antihistamines decreased by 16%, while the number of referrals to an immunologist increased by 24%. There was an 11% reduction in the number of patients who were observed for at least 4 hours.

Conclusion: A number of deficiencies in the management of anaphylaxis presentations have been identified. Targeted educational activities aimed at the Emergency Department hospital staff may improve outcomes.

Key words: Anaphylaxis; Clinical Audit; Emergency Department

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INTRODUCTION

The term anaphylaxis refers to a rapidly progressive, systemic allergic reaction that may be fatal. The definition of anaphylaxis in the literature is quite varied and its aetiology may include both IgE and non IgE mediated mechanisms.

The current definition as agreed upon by the Joint Council of Allergy, Asthma and Immunology; and the American College of Allergy, Asthma and Immunology is as follows [1, 2]:

1. Acute reaction involving mucosal and/or cutaneous tissues with the addition of either: respiratory compromise, end organ dysfunction, hypotension
2. The development of any two of the following after exposure to a LIKELY antigen: mucosal/cutaneous tissue, respiratory compromise, hypotension, gastrointestinal symptoms
3. Hypotension after exposure to a KNOWN allergen

This definition can be difficult to remember and apply to patients in the setting of a busy Emergency Department. However, it is necessary to maintain such a definition to differentiate anaphylaxis from less severe allergic reactions.

Anaphylaxis is a common cause for presentation to the Emergency Department. A recent retrospective case based study of patients aged 13 years and above, over a period of 1 year was performed in a Brisbane hospital, revealing an incidence of 1 in 439 Emergency Department presentations. One conclusion drawn from this study was that a moderate sized Emergency Department could expect to see at least one case of anaphylaxis each week [3].

Given that this is a common and sometimes fatal condition we sought to audit our Emergency Department's management of anaphylaxis and determine if an educational intervention could improve outcomes.

MATERIALS AND METHODS

We performed a retrospective review of the electronic records for all paediatric and adult cases that presented to our Emergency Department. We identified all triage labels or final diagnoses with the terms anaphylaxis, allergy, allergic reaction, rash, urticaria, and angioedema with an aim to identify cases of anaphylaxis and milder forms of immediate type allergic reactions presenting with a combination of urticaria and nonairway threatening

angioedema. While the presence of cutaneous manifestations with nonairway threatening angioedema is not strictly defined as anaphylaxis, we included these events to determine how they were being managed.

We graded the severity of each case using a severity grade adapted from Brown 2006 with mild reactions characterised by urticaria or angioedema not threatening the airway; moderate reactions characterised by nausea, vomiting, abdominal pain, dyspnoea, wheeze, stridor, throat constriction, diaphoresis or chest tightness; and severe reactions characterised by cyanosis or SpO₂ <92%, hypotension (systolic blood pressure <90 mm Hg in adults), confusion and syncope [4].

This grading system was chosen in preference to others because of its practicality and ease of use in an Emergency Department setting. The use of adrenaline, antihistamines, and corticosteroids was reviewed as well as observation time and organisation of follow up with an immunologist/allergist.

After 5 months a targeted education program consisting of a 45-minute lecture discussing the recognition, grading and management of anaphylaxis was provided to the Emergency Department physicians. Our proposed treatment algorithm was also provided (Table 1) and kept in the Emergency Department for rapid access. Data was collected for a further 5 months following this intervention.

As this was a retrospective, deidentified audit for educational and quality control purposes, an ethics submission to our Institutional Ethics Committee was not required.

RESULTS

In the first 5 months of the audit 38 patients met the inclusion criteria (Table 2). When compared to our proposed management algorithm of anaphylaxis many deficiencies in management became apparent. There were no fatalities amongst the 38 patients reviewed.

Severe anaphylaxis (preintervention)

Only 3 patients had severe anaphylaxis, 2 of which had over night observation in hospital and a third who was observed for more than 4 hours in the Emergency Department. None of these patients required ventilatory support. All those with severe anaphylaxis received intramuscular adrenaline and antihistamines, as well as corticosteroids either in the form of hydrocortisone

Table 1. Treatment algorithm provided to emergency staff

1. Discontinue administration or remove causative agent where relevant
2. Assess reaction severity and treat accordingly
For Brown grade 1 (mild) Observe – consider additional treatments specified below
For Brown grades 2 and 3 (moderate/severe) Give adrenaline 1:1,000 IM (lateral thigh) 0.01 mg/kg (maximum dose, 0.5 mg) Give high flow oxygen with airway/ventilation support and salbutamol if required Set up IV access
If hypotensive Set up additional wide bore IV access (14 G or 16 G in adults) Give IV normal saline bolus 20 mL/kg
Repeat IM adrenaline injection every 3–5 minutes, as required. If still not responding consider an IV adrenaline infusion (will need cardiac monitoring) For patients on beta blockers who do not respond to adrenaline use glucagon 20–30 µg/kg (maximum dose, 1 mg in children) administered IV over 5 minutes and followed by an infusion (5–15 µg/min) titrated to clinical response
Additional treatments For all cases the addition of a nonsedating antihistamine such as loratadine 10 mg PO or cetirizine 10 mg PO can be used to manage cutaneous symptoms if required Additionally corticosteroids can be given in the form of prednisone 0.5–1 mg/kg PO or hydrocortisone 2–4 mg/kg IV
Length of observation after treatment Mild - 4 hours Moderate - 4 hours if they respond promptly to treatment; consider admission otherwise Severe - will usually require admission, normally to HDU/ICU
3. Organise adrenaline autoinjector (Epipen) Can be prescribed by Emergency Department physician.
4. Provide an anaphylaxis action plan (can be downloaded from ASCIA website)
5. Organise immunology/allergy review
IM, intramuscular; IV, intravenous; PO, per oral; HDU/ICU, high dependency unit/intensive care unit; ASCIA, Australasian Society of Clinical Immunology and Allergy

given intravenously or prednisone given orally. Follow up with an allergist was not organised for the patient discharged from the Emergency Department.

Moderate anaphylaxis (preintervention)

The treatment of those with moderate anaphylaxis was quite variable. Of the 23 cases in this group under half were treated with adrenaline. Eleven patients were treated with a sedating antihistamine, promethazine. Nine patients were observed for

less than 4 hours while follow-up was only organised for 7 cases.

Mild allergic reaction (preintervention)

There were 12 patients with urticaria and nonairway threatening angioedema. None of these patients received adrenaline. The use of corticosteroids and antihistamines was variable. Sedating antihistamines were used in 3 cases. Nine patients were observed for less than 4 hours and follow-up arrangements with an allergist were organised for only 2 patients.

Postintervention results

In the 5 months after the educational intervention 58 patients met the inclusion criteria (Table 2). There were no fatalities amongst any of these patients. Twenty-three patients had either severe or moderately severe anaphylaxis at onset but their symptoms were mild by the time they reached hospital (Table 2: mild*). Of these 23 patients, nine received adrenaline that was self administered using an adrenaline autoinjector or given by ambulance officers.

Five patients had severe anaphylaxis, with one being discharged without at least 4 hours of observation. None of these patients required ventilatory support. All but 1 patient with severe anaphylaxis received intramuscular adrenaline.

Nineteen patients had moderate severity anaphylaxis with 14 of these being treated with adrenaline, an improvement of 26% compared to the pre-educational intervention group. Two patients in the mild severity group inappropriately received adrenaline. Overall the appropriate use of adrenaline by the emergency staff increased by 21%.

Following the educational intervention the use of sedating antihistamines decreased by 16%, while the number of referrals to an allergist/immunologist increased by 24%. There was a reduction of 11% in the number of patients who were observed for at least 4 hours.

DISCUSSION

Our audit reveals a number of obstacles and deficiencies which have been highlighted in multiple reviews examining the management of anaphylaxis [3, 5, 6]. The first major obstacle relates to the lack of a simple definition of anaphylaxis that can be easily recalled from memory by emergency staff.

As our audit revealed, recognition of the severest forms of

Table 2. Clinical outcomes pre- and posteducational intervention

Brown grade	Adrenaline use (n)	Corticosteroid use (n)	Antihistamine use (n)	Observation time (n)	Follow-up organised (n)
Pre-educational intervention					
Mild (n = 12)	Yes (0)	Hydrocortisone (2)	Sedating (3)	≥4 hours (3)	Yes (2)
	No (12)	Prednisone (7) None (3)	Nonsedating (8) H ₂ antagonist (0) None (2)	<4 hours (9)	No (10)
Moderate (n = 23)	Yes (11)	Hydrocortisone (10)	Sedating (11)	≥4 hours (14)	Yes (7)
	No (12)	Prednisone (7) None (6)	Nonsedating (12) H ₂ antagonist (3) None (3)	<4 hours (9)	No (16)
Severe (n = 3)	Yes (3)	Hydrocortisone (2)	Sedating (0)	≥4 hours (3)	Yes (2)
	No (0)	Prednisone (1) None (0)	Nonsedating (2) H ₂ antagonist (1) None (0)	<4 hours (0)	No (1)
Posteducational intervention					
Mild (n = 11)	Yes (2)	Hydrocortisone (0)	Sedating (4)	≥4 hours (2)	Yes (6)
	No (9)	Prednisone (10) None (1)	Nonsedating (6) H ₂ antagonist (2) None (1)	<4 hours (9)	No (5)
Mild* (n = 23)	Yes (14)	Hydrocortisone (3)	Sedating (1)	≥4 hours (10)	Yes (9)
	No (9)	Prednisone (16) None (4)	Nonsedating (19) H ₂ antagonist (2) None (2)	<4 hours (13)	No (14)
Moderate (n = 19)	Yes (14)	Hydrocortisone (9)	Sedating (6)	≥4 hours (12)	Yes (14)
	No (5)	Prednisone (9) None (2)	Nonsedating (10) H ₂ antagonist (9) None (3)	<4 hours (7)	No (5)
Severe (n = 5)	Yes (4)	Hydrocortisone (4)	Sedating (1)	≥4 hours (3)	Yes (3)
	No (1)	Prednisone (0) None (1)	Nonsedating (2) H ₂ antagonist (1) None (1)	<4 hours (2)	No (2)

*This group had anaphylaxis at onset but their symptoms settled by the time they were triaged in the Emergency Department.

anaphylaxis is often achieved leading to prompt and appropriate management in the majority of cases. Patients with moderate severity anaphylaxis are frequently inappropriately categorised and often receive inadequate or inappropriate treatment.

Another common problem identified was the inadequate use of adrenaline. Despite the well established role of adrenaline in the management of anaphylaxis it is not uncommon for this life saving medication to be withheld. A multicenter study looking at Emergency Department visits for food allergy revealed that among patients with severe reactions only 24% received adrenaline. Of the 97% of patients that were discharged from the Emergency Department, only 16% of patients were prescribed an

adrenaline auto injector [7].

In our cohort, 54% of patients with moderate and severe anaphylaxis received adrenaline prior to the educational intervention. This increased to 75% following the intervention. Misconceptions about the safety profile of adrenaline lead to it being withheld in preference for drugs that are perceived to be safer alternatives i.e., antihistamines, salbutamol and corticosteroids. While these can supplement the use of adrenaline, none take its place in the treatment of bronchospasm and vascular collapse which are common features of severe anaphylaxis. In the context of moderate to severe anaphylaxis the benefits of using adrenaline outweigh the risks [8-10].

Prospective controlled trials looking at the efficacy of adrenaline cannot be performed for ethical reasons as patients cannot be randomised to a placebo arm. However, retrospective studies have shown that fatalities, caused by anaphylaxis, generally occur as a result of delay in administration of adrenaline supporting the beneficial role of this drug [11, 12].

Antihistamines aid in treatment of urticaria and rhinorrhoea associated with anaphylaxis but do not prevent or relieve bronchoconstriction, airway angioedema or vascular collapse [13]. First and second generation H₁ antihistamines are very frequently prescribed for the management of anaphylaxis as they are often viewed as being harmless drugs and safer to give than adrenaline. This misconception can result in delay in the administration of adrenaline. Promethazine, the only H₁ antihistamine available in the intravenous form in Australia, is often given in preference to oral formulations of nonsedating H₁ antihistamines and can exacerbate hypotension by causing vasodilatation. Promethazine is capable of crossing the blood brain barrier occupying over 70% of the H₁ receptors within the brain [14]. This can lead to side effects such as drowsiness which can confuse the clinical presentation of severe anaphylaxis with central nervous system hypoperfusion and as such should be avoided in the setting of anaphylaxis [13, 14]. Second generation H₁ antihistamines do not readily cross the blood brain barrier and are generally free of these side effects. They are also less likely to cause the antimuscarinic, antiserotonin, and anti- α adrenergic side effects common to first generation H₁ antihistamines [14].

Insufficient observation time was another problem identified. The observation time appeared to be proportionate to the severity of the reaction in most cases. This could reflect a lack of knowledge about biphasic and protracted anaphylaxis and the need for appropriate observation time. Unfortunately there was an 11% reduction in the number of patients observed for at least 4 hours. This is likely to reflect a pressure to clear beds and meet bench marks around patient turnaround times in the Emergency Department.

The final issues related to discharge with an adrenaline auto-injector and follow up with an immunologist. Only 11 of the 38 patients reviewed prior to the education intervention had an appointment organised with an immunologist and none were prescribed an adrenaline auto-injector or given an anaphylaxis action plan unless they were reviewed by an immunologist while in hospital. Most of the patients were advised to return to the Emergency Department if their symptoms returned.

Again this probably reflects a lack of appreciation of the life saving role of adrenaline in the management of anaphylaxis and a lack of knowledge on how to prescribe this drug from the Emergency Department. In the 5 months after the educational intervention 17 patients were identified that should have been prescribed an adrenaline auto-injector but only 6 received a prescription. While this is an improvement compared to the pre-educational intervention group, there is still much progress to be made in this area. Fortunately the number of referrals to an allergist/immunologist increased by 24% an indication that the educational intervention increased awareness regarding the need for appropriate follow-up.

We have shown that a single educational intervention can improve many outcomes including appropriate adrenaline use, sedating antihistamine avoidance, and referral to allergy/immunology services. However, there is much progress to be made and this will likely require regular education sessions with the Emergency Department staff particularly as there is usually a high turnover of staff in these departments.

In conclusion, our audit reveals a number of deficiencies in the management of anaphylaxis. Unfortunately these deficiencies are not unique to our Emergency Department. Failure to identify and grade anaphylaxis correctly often leads to delayed or inappropriate treatments. Inadequate Immunology/Allergy follow-up and failure to prescribe adrenaline auto injectors on discharge from the Emergency Department are all major deficiencies which need to be addressed. We have shown that targeted educational activities aimed at the Emergency Department hospital staff may improve outcomes.

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