

Classification of anaphylaxis and utility of the EAACI Taskforce position paper on Anaphylaxis in Children

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Abstract

Correct management and classification of anaphylaxis is mandatory. Records of emergency department (ED) visits to any of the three pediatric hospitals in Stockholm, because of reactions to foods during 2007, were identified. A retrospective analysis of clinical ED records of 371 children with 381 unique occasions of reactions to foods was performed. Symptoms/signs of reactions to foods recorded for classification of anaphylaxis were related to those presented in the EAACI Taskforce position paper on Anaphylaxis in Children (Allergy 2007; 62: 857). Forty-six different symptoms/signs of reactions to foods were retrieved. Several severe signs or symptoms from the respiratory tract and signs indicating reduced brain perfusion were not described in detail in the EAACI paper, hampering correct classification of anaphylaxis including grading of severity in our material. After modification of the EAACI classification including such signs and symptoms, we were able to classify 128 (35%) children with anaphylaxis. Seventy children (19%) did not fulfill our modified EAACI's criteria for anaphylaxis. They had been given adrenaline before or at arrival to hospital, possibly preventing anaphylaxis. Another 173 (47%) children/adolescents had neither been given adrenalin, nor fulfilled the criteria for anaphylaxis. Classification of food-induced anaphylaxis and severity grading should be built on signs and symptoms to facilitate diagnosis. The existing EAACI tool is helpful, but for Swedish children it is not quite applicable, in particular because of the lack of description of some respiratory, neurological or possible cardiovascular signs and symptoms.

Anaphylaxis is potentially life-threatening, and the diagnosis is based on clinical history and physical findings (1). Guidelines for recognition and grading of severity of anaphylaxis have been endorsed by several taskforce groups (1–4).

The primary aim of our study was to identify children admitted to pediatric emergency departments (ED) in Stockholm County during 2007 with an acute reaction to foods. The secondary aim was to identify anaphylaxis to foods and to grade severity of anaphylaxis among these children by utilizing the EAACI position paper on anaphylaxis in children (1).

Material and methods

Clinical ED records of all children (age 0–18 yrs) who had been admitted to any of the three pediatric hospitals within

Stockholm County: Sachs' Children's Hospital, Astrid Lindgren's Children's Hospital, and Huddinge Hospital, Department of Pediatrics, for an acute reaction to foods during January 1 to December 31 2007 were included for review (Fig. 1).

In order to identify the patients with suspected acute reactions to foods, a total of 15 discharge codes were used (Table 1). The *International Classification of Disease, Tenth Revision (ICD-10)* was used. We performed a pre-review of records of children admitted during the first 3 months of 2007 to Sachs' Children's Hospital with ICD codes J45, L20, L24.6, L27, and K52.2 as the only diagnosis to find out whether any of the admittances behind these codes were described as reactions to food. Because we did not identify any child with food-elicited reactions in this group of

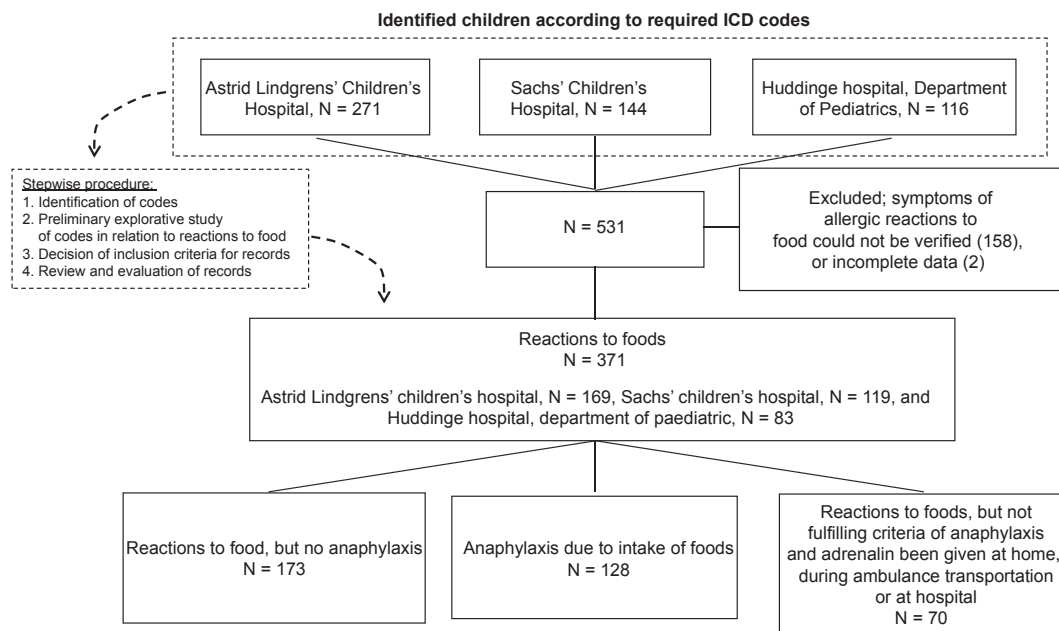


Figure 1 Flowchart of children with reviewed clinical records from emergency department visits at any of the three pediatric hospitals in Stockholm, Sweden, 1 January to 31 December 2007.

children, records with these ICD codes only were not reviewed further.

Clinical records of the 531 children fulfilling the selection criteria using the ICD codes mentioned earlier were manually reviewed (MV, CL, DH). For all uncertain cases, two trained allergologists (DH, MW) took the decision on inclusion or not in our study. A total of 160 children were excluded as there was no information in their ED records of a possible acute reaction to foods ($n = 158$) or data in the clinical

records was incomplete ($n = 2$). The remaining 371 children all had reactions or highly suspected reactions to foods of whom 27 were found to have more than one ED visit caused by acute reactions to foods leaving 398 clinical records of 371 children for final review (Fig. 1). Among the 27 children who had reacted at least twice, we only included records of the repeated ED visit/visits if the child had reacted to different foods ($N = 10$). As to the remaining 17 children for whom repeated ED visit/visits were caused by acute reactions to the same food as in the first ED visit, we only included the first admittance for further review in order not to oversample symptoms to a specific food.

In the next step, we tried to classify the included 381 observations in 371 children according to the severity of the acute reaction to foods. For this purpose, we used as gold standard the EAACI position paper on anaphylaxis in children with classification of anaphylaxis and grading of severity (1). Three children who at their first admittance were not classified with anaphylaxis were found to fulfill the criteria of anaphylaxis at their second admittance with reaction to the same foods. Even for these three children, only the first admittance has been reviewed. At re-admittance, they did not present with symptoms/signs not already found among the reviewed 381 records.

All symptoms and signs from each ED visit record were entered in one single database for all three hospitals. The database was designed for this purpose and with data entry over Internet (Viedoc; Pharma consulting group, Uppsala, Sweden). Three in our group (MV, CL, and DH) had their own unique usernames and passwords for data entry. Security requirements were fulfilled. Symptoms and signs

Table 1 The discharge codes initially included for retrieval of clinical ED records and identified from the *International Classification of Disease, Tenth Revision (ICD-10)*

Code	Diagnosis
J45	Asthma
K52.2	Allergic and dietetic gastroenteritis and colitis
L20	Atopic dermatitis
L27	Dermatitis due to substances taken internally
L24.6	Irritant contact dermatitis due to food in contact with skin
L50.0	Allergic urticaria
L50.9	Urticaria, unspecified
T78.0	Anaphylactic shock due to adverse food reaction
T78.1	Other adverse food reactions, not elsewhere classified
T78.2	Anaphylactic shock, unspecified
T78.3	Angioneurotic edema
T78.4	Allergy, unspecified
T78.8	Other adverse effects, not elsewhere classified
T78.9	Adverse effect, unspecified
Z91	Personal history of risk-factors, not elsewhere classified

ED, emergency department.

entered in our database were those registered by ambulance-personal and health care staff at the ED, with the exception of the symptoms of vomiting and diarrhoea, which could have occurred shortly before admittance. The study was approved by the ethics committee of Karolinska Institutet, Stockholm.

Results

Forty-six different symptoms or clinical signs associated with acute reactions to foods could be retrieved from clinical ED records in 381 observations in our study (Table 2). Identification and severity grading of anaphylaxis according to the EAACI position paper on anaphylaxis in children (1) was associated with some difficulties. First, we found four symptoms in the clinical records indicative of respiratory involvement that are not mentioned in the EAACI paper, namely chest tightness, non-barky cough, speaking difficulties, and speaking with a 'muffled' voice. Furthermore, in clinical records of 12 children the term 'affected breathing pattern' was used as the only respiratory sign. These five symptoms not mentioned in the EAACI paper were considered indicative of respiratory compromise by us. As to severity grading of anaphylaxis, children with affected breathing pattern or chest tightness were considered by us as having mild anaphylaxis, whereas children with cough, speaking difficulties, and/or speaking with a 'muffled' voice were graded as having moderate anaphylaxis.

Second, in the EAACI paper abdominal pain could be classified as mild or crampy and wheezing as mild to moderate. This hampered our retrospective classification of anaphylaxis because such subjective signs/symptoms could not always be retrieved by us. Children with abdominal pain or wheeze were by us considered as having moderate anaphylaxis. Third, symptoms such as tiredness or somnolence (found in 17 children) were not defined in the EAACI paper. Children fulfilling the criteria for anaphylaxis with the symptom tiredness were by us classified as having mild anaphylaxis, whereas somnolent children were classified as having moderate anaphylaxis.

After these modifications, 128 (35%) children fulfilled the criteria of anaphylaxis of whom 4% were classified as having mild, 81% as having moderate and 15% as having severe anaphylaxis. Nineteen per cent ($n = 70$) of the children had been given adrenaline at home, in the ambulance or at arrival to hospital without fulfilling the criteria for anaphylaxis. Another 173 children/adolescents had neither been given adrenalin nor did they fulfill the criteria of anaphylaxis.

Discussion

In this retrospective review of clinical records of all pediatric hospitals in Stockholm County, we identified 371 children who had been admitted for acute reactions on 381 occasions to different foods during 2007. They presented with 46 various symptoms or clinical signs in total of which 37 had recently been described in the EAACI position paper on anaphylaxis in children (1).

Table 2 Symptoms and signs of children with anaphylactic reactions described in the EAACI Taskforce on Anaphylaxis in Children position paper and found by us after reviewing clinical records of acute reactions to foods of any of the three pediatric hospitals in Stockholm, 1 January to 31 December 2007

	EAACI Taskforce on Anaphylaxis 2007	Children ED Food Allergy Study 2007, Stockholm
Skin		
Itching	X	X
Flushing	X	X
Urticaria – local	Not specified	X
Urticaria – generalized	Not specified	X
Angioedema	X	X
Eczema	0	X
Oral cavity		
Oral pruritus	X	X
Oral 'tingeling'	X	X
Lip swelling (mild)	X	X?
Gastrointestinal		
Vomiting	X	X
Abdominal pain	X	X
Diarrhoea	X	X
Loss of bowel control	X	X
Respiratory – upper		
Rhinorrhoea	X	X
Nasal congestion/sneezing	X	X
Conjunctivitis	0	X
Throat pruritus	X	X
Tightness in mouth/throat	X	X
Lumpiness in throat	0	X
Hoarseness	X	X
Difficulty swallowing	X	X
Speaking difficulties	0	X
Muffled voice	0	X
Barky cough	X	X
Lower respiratory		
Cough	0	X
Increased phlegm production	0	X
Mild wheezing	X	X?
Moderate wheezing	X	X?
Stridor	X	X
Dyspnoea	X	X
Affected breathing pattern	0	X
Chest tightness	0	X
Saturation <92%	X	X
Respiratory arrest	X	X
Cardiovascular		
Tachycardia*	X	X
Dysrhythmia	X	X
Bradycardia	X	X
Hypotension	X	X
Collapse	X	X
Cardiac arrest	X	0
Neurological		
Change in activity level	X	X
Tiredness	0	X
Somnolence	0	X

Table 2 (Continued).

	EAACI Taskforce on Anaphylaxis 2007	Children ED Food Allergy Study 2007, Stockholm
Anxiety	X	X
Increased activity level	0	X
Dizziness	X	X
Confusion	X	0
Loss of consciousness	X	X
'Light headedness'	X	0
'Feeling of 'pending doom'	X	0

X: symptoms described/retrieved; 0: not described/retrieved; *Possible side effect of adrenalin; ?: difficulties to retrieve because of subjective wording. ED, emergency department.

Because our study was based on a retrospective review of clinical records, we had to go for what could be retrieved. In 12 children of our study 'affected breathing pattern' was the only respiratory sign recorded. This could be a symptom of the upper and/or the lower airways presumably caused by wheeze, dyspnoea, or stridor. We classified affected breathing pattern as being a sign of mild anaphylaxis in order not to oversample the group of children with moderate or severe anaphylaxis.

Abdominal pain can either be mild or crampy, and wheeze can be either mild or moderate, according to the EAACI

position paper. The classification into mild or moderate of a certain symptom is rather subjective and is up to the physician at the ED to decide on. This may bias grading of severity of anaphylaxis.

Speaking difficulties, but also symptoms from the larynx such as hoarseness or speaking with a 'muffled' voice, need to be considered as potentially life-threatening symptoms. Description of speaking difficulties and speaking with a muffled voice are missing in the EAACI position paper as well as symptoms of non-barky cough and chest tightness.

Tiredness or various levels of sleep were especially mentioned in 19 clinical records as signs of an adverse reaction. Somnolence but also tiredness can be misinterpreted by health care staff as a normal phenomenon after an allergic reaction, but might as well be symptoms of anaphylaxis as a result of reduced brain perfusion induced by airway or circulation problems, which can alter the patient's neurological status (4). Thus, a rather precise description of such symptoms would be warranted. However, in the EAACI position paper, 'change in activity level' is mentioned but not more precisely, as well as confusion and loss of consciousness.

The fact that we could not identify clinical records in which confusion or cardiac arrest was mentioned does not mean that these symptoms do not exist. Larger material is likely needed to find such patients.

It is notable that the group of children classified with mild anaphylaxis was substantially small ($N = 5$) in comparison with the group of children with moderate anaphylaxis

Table 3 Suggested modification of the EAACI Taskforce position paper on Anaphylaxis in Children table 'Grading the severity of anaphylactic reactions' after review of 381 clinical records of 371 children who visited any of the three pediatric hospitals in Stockholm during 2007

Grade	Skin	GI-tract	Respiratory	Cardiovascular	Neurological
1 Mild	Sudden itching of eyes and nose, generalized pruritus, flushing, urticaria, angioedema	Oral pruritus, oral 'tingling', mild lip swelling, nausea or emesis, mild abdominal pain	Nasal congestion and/or sneezing, rhinorrhea, throat pruritus, throat tightness, mild wheezing, chest tightness	Tachycardia (increase >15 beats/min)	Change in activity level, anxiety, tiredness
2 Moderate	Any of the above	Any of the above, crampy abdominal pain, diarrhoea, recurrent vomiting	Any of the above, hoarseness, cough , barky cough, swallowing or speaking difficulties , muffled voice , stridor, dyspnoea, moderate wheezing	As above	'Light headedness', feeling of 'pending doom', somnolence
3 Severe	Any of the above	Any of the above, loss of bowel control	Any of the above, cyanosis or saturation <92%, respiratory arrest	Hypotension* and/or collapse, dysrhythmia, severe bradycardia and/or cardiac arrest	Confusion, loss of consciousness

This table is based on the 128 children who all had anaphylaxis to foods. The symptoms added by us are marked in bold.

The severity score should be based on the organ system most affected.

*Hypotension defined as systolic blood pressure: 1 month to 1 yr <70 mmHg, 1–10 yrs < [70 mmHg + (2 × age)]; 11–17 yrs <90 mmHg.

(N = 104). However, when using the clinical criteria for the diagnosis of anaphylaxis and severity grading proposed in the EAACI position paper, this finding was expected.

There are some weaknesses in our study though. In a retrospective review of clinical ED records, inclusion of sometimes vague symptoms and signs will rely on the single health professional's subjective feeling but also level of competence on the specific topic. The sometimes intense work load on an ED will also lead to that milder symptoms, or signs will likely not be mentioned in the clinical records. However, it is likely that even in a prospective study such weaknesses will minimize only to some extent.

To our knowledge, this is the first study where the utility of a position paper on management of childhood anaphylaxis has been tested. We believe that descriptions of symptoms and signs of the respiratory tract, larynx, and symptoms of reduced brain perfusion could be improved, which is attempted by us in Table 3. However, changes of the position paper by using more relevant wordings or descriptions in order to increase implementation need to be carried out by others. Furthermore, it would be advantageous and of great help if subjective descriptions such as mild or moderate could be changed to objective parameters. However, our suggested changes need to be validated in a prospective study.

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