

Impact of Specific Training in Anaphylaxis for Triage Nursing Staff in the Pediatric Emergency Department of a Tertiary Hospital

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■ Abstract

Background: After a diagnosis of anaphylaxis, patients receive action management plans to prevent and treat new episodes, including attending the emergency department for follow-up or further treatment. In a previous study, we observed that more than half of the children with anaphylaxis were incorrectly prioritized in our Pediatric Emergency Unit (PEU), thus delaying their treatment. In conjunction with our PEU staff, we designed a basic educational intervention (BEI) to try to solve this problem. We analyzed the effect of the intervention on triage of children subsequently diagnosed with anaphylaxis.

Methods: Our BEI consisted of a training lecture given to the PEU triage nurses and the design of a reference card highlighting symptoms and risk factors of anaphylaxis.

We included 138 children with a medical diagnosis of anaphylaxis and assessed modifications in their triage priority level and waiting times (WT) before seeing a physician after our intervention. According to the BEI implementation date, 69 children were diagnosed before the intervention (G1) and 69 after (G2). Clinical data were compared to assess the severity of the episodes.

Results: There were no differences between the groups. WT decreased (from 8 to 1 minute; $P=.03$), and the number of correctly identified patients increased after the BEI (36.2% [G1] and 72.2% [G2]; $P=.0001$).

Conclusions: Our BEI was effective, improving the identification and prioritization of children with anaphylaxis and reducing their WT. We need to pay attention to the functioning of our patients' reference emergency department and establish interdisciplinary measures that enable optimal management of anaphylaxis.

Key words: Triage. Anaphylaxis management. Children. Educational intervention. Specific education. Nursing staff. Multidisciplinary. Paediatric Canadian Triage and Acuity Scale (PaedCTAS).

■ Resumen

Introducción: Tras un diagnóstico de anafilaxia los pacientes reciben planes de tratamiento para prevenir y tratar nuevos episodios, que incluyen acudir a Urgencias para control o tratamiento subsiguientes. Previamente, nuestro grupo había observado que más de la mitad de los niños con anafilaxia eran priorizados incorrectamente en nuestra Unidad de Urgencias de Pediatría (UP). Elaboramos, en colaboración con el personal de UP, una intervención educativa básica (IEB) para resolver el problema. Analizamos el efecto de dicha intervención en el triaje de los niños atendidos posteriormente por anafilaxia.

Métodos: Nuestra IEB consistió en una sesión clínica para el personal de enfermería responsable del triaje y diseñamos una *Reference Card* destacando síntomas y factores de riesgo de anafilaxia.

Incluimos 138 niños con diagnóstico de anafilaxia, analizando los cambios en el nivel de prioridad, tiempos de espera para valoración médica (TEM) tras nuestra IEB. Según la fecha de implementación, 69 niños fueron atendidos antes (G1) y el resto después (69). Se compararon además los datos clínicos de los episodios.

Resultados: No hubo diferencias en los datos clínicos entre grupos. Los TEM disminuyeron (de 8 a 1 minutos [$p: 0,03$]), incrementándose las cifras de pacientes priorizados correctamente (36,2% [G1] y 72,2% [G2][$p=0,0001$]) tras nuestra intervención.

Conclusiones: Nuestra IEB ha sido eficaz, mejorando la identificación, priorización de los niños con anafilaxia y reduciendo los TEM. Debemos conocer el funcionamiento de los Servicios de Urgencias de referencia para nuestros pacientes y establecer medidas multidisciplinarias que optimicen el manejo de la anafilaxia.

Palabras clave: Triaje. Manejo de la anafilaxia. Niños. Intervención educativa. Educación específica. Personal no-médico. Multidisciplinar. Sistema Canadiense de Triaje Pediátrico (PaedCTAS).

Background

The incidence of anaphylaxis in Spain is estimated at 0.9 episodes per 1000 emergencies [1], although this figure is increasing [2]. Allergy departments provide patients with an action management plan to prevent and treat anaphylaxis, including the recommendation to attend the emergency department (ED) after an episode [3-6]. However, guidelines do not consider the role of triage in the daily routine of the ED [3-5].

Our Pediatric Emergency Unit (PEU) cares for approximately 40 500 children annually. It has a specific triage system with computerized support, which since 2012 has been based on the Paediatric Canadian Triage and Acuity Scale (PaedCTAS) [7,8]. Triage is performed by nursing staff and includes 5 priority levels with recommended waiting times for medical care, as follows: I, resuscitation, immediate attention; II, very urgent (15 minutes); III, urgent (30 minutes); IV, less urgent (60 minutes); V, nonurgent (120 minutes) [7-8]. Priority levels are assigned following a series of steps.

First, patients are visually evaluated in terms of general appearance, respiratory distress, external signs, and skin perfusion based on the Pediatric Assessment Triangle [5,6,9]. Depending on the number of altered sides,

patients receive initial priority levels, as follows: Level 1, 3 altered sides; Level 2, 2 altered sides; Level 3, 1 side; Level 4-5, None.

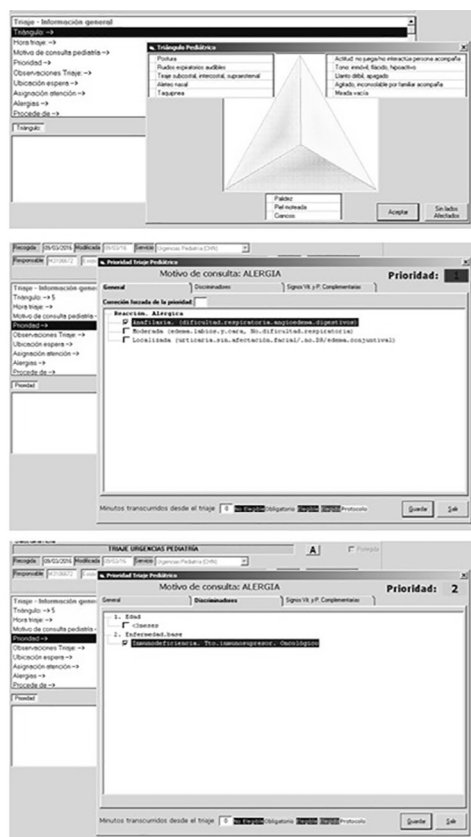
The main complaint is then evaluated, and the initial priority level is modified. Priority allocation in patients with allergy is based on skin symptoms, as follows: facial angioedema, level III; isolated urticaria, level IV. If skin symptoms are associated with involvement of another organ, priority changes to level II. If nursing staff diagnose anaphylaxis at triage (irrespective of their role assessing other symptoms), patients are assigned to level I priority [7,8-10].

Previously, we evaluated how our system prioritized children attended for anaphylaxis in the PEU, noting that 66% were underprioritized and thus experienced delays in receiving their treatment [10]. Other authors have reported similar results [11].

We designed a basic educational intervention (BEI) jointly with PEU staff. The intervention consisted in a teaching session for triage personnel and a reference card (Figure) highlighting anaphylaxis symptoms and risk factors.

Objective

We assessed the efficacy of these measures with respect to the prioritization and waiting times of patients who were



1. Patient's history compatible with anaphylaxis, **2 or more organs involved**
 - Priority I (*Resuscitation Room*) or Priority II (*Box 1*)
 - Compatible Symptoms and Stable PAT: Priority II (*Box 1*)
 - Patient who used an EA: Priority II (*Box 1*)
2. Patient's history compatible with urticaria, **only skin involvement**: Priority IV (*Waiting Room*)
 - **Ask for symptom duration:**
 - > 6 hours: **Not anaphylaxis**
 - < 2 hours: **Ask for non-skin-related symptoms** Priority II (*Box 1*)
3. **Time elapsed between exposure and onset of symptoms > 6-8 hours**: Priority IV (*Waiting Room*)

DISCRIMINATORS

- Previous anaphylaxis: II
- EA prescription: II
- EA use: II
- Food allergy: III
- Bronchial asthma: III

NURSE ACTIONS IN ANAPHYLAXIS:

- Anticipate patient's needs: Oxygen, epinephrine, peripheral line, blood sample for tryptase determination (most useful 60-90 min after the onset of symptoms)
- Monitor in observation room for 6-8 hours

Figure. Left Column: Anaphylaxis triage procedure "before". A diagnosis of anaphylaxis by triage nursing staff leads to level I priority. Right Column: Reference Card. Box 1: Immediate Attention Room. PAT indicates Pediatric Assessment Triangle or "first impression"; EA, epinephrine autoinjector.

subsequently treated and who received a medical diagnosis of anaphylaxis.

Methods

Design

We included 138 children. We analyzed PEU discharge reports of children aged under 15 years coded as *anaphylaxis or nonspecified allergy*. The medical diagnosis of anaphylaxis was confirmed from the discharge charts by 2 allergists according to current guidelines [3-6]. Information regarding triage of these patients was collected on separate sheets, which were the object of our analysis.

Sixty-nine of the patients who had been attended between October 2014 and March 2016 had taken part in our previous study and formed group G1 [10]. In April 2016, we applied the BEI to nursing staff performing triage. We included an equal number of children who had been evaluated in the PEU after the BEI, following the same inclusion criteria as G1 (group G2, 69 patients).

The study was approved by the Hospital Clinical Research Ethics Committee.

Improvement Measures/Reference Card Design

The information given was agreed between 2 allergists, 2 PEU pediatricians, and 2 nurses experienced in pediatric triage (Figure). This included a clinical session for PED nursing and auxiliary staff, emphasizing symptom recognition and initial assessment. In addition, a reference card was included to be used in daily practice. The card covers anaphylaxis symptoms, risk factors [12-13], recommended priority levels, and patients' location in the PEU (immediate attention room, treatment room, general waiting room) according to their final priority.

Variables for Analysis

The primary outcome measures were whether our intervention reduced waiting times (time of medical chart registration minus time of arrival at PEU registration) before administration of medical care and the number of undertriaged children. We recorded the initial triage level, which was based on our first impression, and the final level, which was established once the triage process was complete. The patient's location in the PEU was also assessed.

In order to verify that both groups were comparable, we analyzed a series of secondary outcome measures, as follows:

- Demographics (age and sex)
- Allergological history: previous anaphylaxis, previous prescription of epinephrine autoinjectors, food allergy, and asthma
- Clinical data on the episode of anaphylaxis in progress
- Medical treatment received after the medical evaluation

From the information on the triage sheet, we analyzed the suspicious observations of anaphylaxis recorded by nursing staff.

We retrieved data regarding symptomatic patients during medical examination and administration of epinephrine from the medical discharge charts.

Statistical Analysis

We used SPSS 22.0 for Windows (IBM Corp), which was released in 2013, and IBM SPSS Statistics for Windows, Version 22.0. (IBM Corp). Demographics and waiting times were analyzed using the Mann-Whitney test. The χ^2 test was used to analyze initial triage levels according to PAT, symptomatic patients, administration of epinephrine, and previous allergies and observations were analyzed. Statistical significance was set at $P < .05$.

Results

After the independent analysis of the discharge reports coded as *anaphylaxis and nonspecified allergy*, 69 patients were included in G2. Previously, 8 cases coded as *anaphylaxis* had been ruled out, and 5 cases coded as *nonspecified allergy* had been included. One of the cases ruled out was a boy who was undergoing a drug allergy desensitization protocol and had been transferred from the outpatient hospital and did not require formal triage. The remaining 7 cases did not meet the criteria for anaphylaxis [3-6]. Alternative diagnosis included acute urticaria episodes, concomitant bronchial asthma and rhinoconjunctivitis, infectious urticaria, and intense oral allergy syndrome.

G1 patients had previously been assessed [10] and underwent the same inclusion procedure.

Primary Outcomes (Table)

The rate of accurately triaged patients (level I or II) rose from 36.2% in G1 to 72.2% in G2 ($P = .001$). The most frequent triage level in G1 was level III. Triage level II, followed by level I were the most frequent in G2. A few patients from both groups were triaged to level IV (8.7% [G1] and 1.4% [G2]).

Median waiting time diminished significantly from 8 to 1 minute ($P = .004$). The patient's location in the emergency department changed in G2, since more than 75% of patients were attended in an immediate attention room (compared with 53% in G1). The percentage of patients located in the waiting room decreased to less than 10% in G2.

Secondary Outcomes (Table)

The number of observations compatible with anaphylaxis recorded in the triage sheets by nursing staff increased from 51.1% to 76.8% ($P = .002$) after our intervention. Among the observations recorded in the triage chart, the number of patients classified as *allergic reaction* or *skin symptoms* diminished, and the number classified as *anaphylaxis-compatible symptoms* increased, doubling the number of G1 patients (not shown in the Table). In G1, 2 out of 3 patients who had used an epinephrine autoinjector before attending the ED were under-triaged to level III. In contrast, the 2 patients who had used an autoinjector in G2 were accurately triaged.

Table. Characteristics of Patients Treated for Anaphylaxis in the Emergency Department

Triage Features	G1	G2	P
Demographics			
Age, mo	58	60	1
Sex, male/female	56.5%/36.5%	55.1%/44.9%	.864
Previous allergy conditions			
Allergy	33 (47.8%)	33 (47.8%)	1
Anaphylaxis	18 (26.1%)	22 (31.9%)	.453
Prescription of EA	18 (26.1%)	22 (31.9%)	.453
Bronchial asthma	25 (36.2%)	14 (20.3%)	.03
Current episode features			
Signs during medical examination, yes/no ^a	38 (55.1 %)	43 (61.1 %)	.605
Administration of epinephrine in the PEU	42 (60.9%)	42 (60.9%)	.607
Referral			
Self-referred	57 (82.6%)	50 (72.2%)	.03
Triage level given by PAT			
1	1 (1.4%)	2 (2.9%)	
2	-	5 (7.2%)	
3	9 (13%)	12 (17.4%)	
5 ^b	59 (85.5%)	50 (72.5%)	
First impression (normal vs altered)	59 (85.5%)	50 (72.5 %)	.101
Anaphylaxis-compatible observations, yes/no	38 (55.1%)	53 (76.8%)	.002
Final triage level			
I	14 (20.3%)	25 (36.2%)	
II	11 (15.9%)	25 (36.2%)	
III	38 (55.1%)	18 (26.1%)	
IV	6 (8.7%)	1 (1.4%)	
V	-	-	
Accurately triaged patients ^c	25 (36.2%)	50 (72.2%)	.001
Allocation at PEU			
Immediate attention	37 (53.6%)	55 (76.4%)	
Treatment room	9 (13%)	10 (13.9%)	.001
Waiting room	23 (33.3%)	7 (9.7%)	
Waiting time for physician, min	8	1	.004

Abbreviations: EA, epinephrine auto-injector; PAT, Pediatric Assessment Triangle; PEU, Pediatric Emergency Unit.

^aNonskin signs documented by the attending physician during the physical examination performed after triage.

^bThere is no triage level 4 in triage levels given by PAT.

^cPatients triaged to levels I or II.

Both groups were comparable in demographic data and previous allergic diseases, except for bronchial asthma, which was more frequent in G1 patients. Anaphylaxis was highlighted as a diagnosis in the *allergies* tab of our medical record program in 10 cases (5 patients per group). Both groups were also comparable in terms of the characteristics of the episode analyzed: *first impression* of the child observed during triage, involvement of organs other than the skin recorded by the pediatrician, and administration of epinephrine in the PEU. As for referral of patients, a significantly greater number of patients in G2 had been referred from another center (34.8% in G2 vs 17.4% in G1; $P=.03$). However, isolated analysis of referred patients showed no differences in the final priority level assigned: 41.7% in G1 and 52.2% in G2 were prioritized correctly (not shown in the Table).

Discussion

After a diagnosis of anaphylaxis, patients receive an action management plan to prevent and treat new episodes. The plan includes the indication to attend the ED for follow-up or further treatment. Patients and caregivers do not always adhere to their plan [14-16]. Allergists are confident that patients with anaphylaxis are attended immediately in the ED. However, we are not aware of the role of triage in the current functioning of the ED.

Triage is defined as “the procedure of sorting out and classifying patients or casualties to determine both the priority of need for medical care and the proper place of treatment” [17].

We recently analyzed how our hospital's triage system classified a group of children who were subsequently diagnosed with anaphylaxis [10] and found that 66% were undertriaged and that this delayed their medical care.

We verified how application of educational measures for nursing staff responsible for triage modified management of anaphylaxis in our PEU. After our intervention, more than 70% of children with anaphylaxis were correctly prioritized and attended in an immediate attention room. Waiting times for medical assessment diminished dramatically. The patient's location in the ED influences the possibility of being monitored closely and increases the chances of receiving immediate attention in the case of deterioration.

Triage is the place where anaphylaxis should be identified; however, surprisingly, most guidelines do not envisage this possibility [3-5]. The *Manual de Anafilaxia Pediátrica* (MAP [Manual of Pediatric Anaphylaxis]) recently included a recommendation to prioritize anaphylaxis to medical care levels I or II in 5-level triage systems, stressing the importance of symptom recognition beyond general appearance [6]. Many patients may appear stable during the initial impression [9] (see Results) and may attend the ED after being treated in other health centers or after self-treatment.

Analysis of final triage levels shows that, unlike patients in G1, only 1 patient in G2 was prioritized to level IV (less urgent). Besides, the most frequent priority level in G1 was III (urgent). After our intervention, the most frequent triage level shifted to levels I and II (immediate attention).

In both groups, the most frequently collected observation was *anaphylaxis-compatible symptoms*. In G2, the number of observations increased significantly. The frequency of nonspecific comments such as *allergic reaction*, *cutaneous symptoms* diminished. This is attributable to both measures: the theoretical training of nursing staff in the concept of anaphylaxis and the availability of the reference card, which helps to remember and recognize the signs and symptoms through key words.

The literature on triage training does not include specific recommendations about previous experience in pediatrics or formal triage training. It has been suggested that nursing staff performing triage duties should have at least 1 year of experience in pediatric nursing [18]. We had no influence on our hospital's recruitment policies, nor were we able to obtain data on individual training or prior triage experience of our triage nursing staff. However, we believe this did not affect our results, considering that the patients were attended over a 3-year period with no changes in recruitment policies.

Finally, 2 allergists analyzed the discharge reports independently and ruled out anaphylaxis in 10% of cases. This finding reinforces the need for close collaboration between the allergy and emergency departments to develop joint management protocols and to establish measures for training and updating in allergic diseases, at least in those as relevant as anaphylaxis.

Allergists can play several roles with respect to the procedures followed for triage of allergic patients. First, they must identify patients at risk by carefully recording allergy and previous anaphylaxis episodes in their computerized clinical history. In our sample, during data collection, we observed that elicitors were better identified than in previous

anaphylaxis episodes in patients who had already undergone allergy work-ups. Second, in the allergy clinic, allergists should advise patients to use the term *anaphylaxis* instead of terms such as *allergy* or *hives* when they go to the ED. Prescriptions of epinephrine autoinjectors by allergists would also identify patients at risk of anaphylaxis and/or with previous episodes.

The expertise of specialists in specific diseases means that their insights are useful when planning changes in triage systems owing to their knowledge of specific diseases [19]. Therefore, allergists may and should help to analyze the *allergies* category in current triage systems jointly with ED specialists. With respect to training, Farbman et al [11] showed how educational measures reduced anaphylaxis-related admission rates. Our results show that carrying out training activities aimed at triage staff and introducing adjustments in the triage system to take account of the peculiarities of anaphylaxis improved identification of patients and dramatically reduced waiting times for medical attention. In our hospital, this improvement has been maintained for 18 months since the implementation of such measures.

Our study has several limitations. It was performed in a single center, with a single triage system and a specific computerized support program. While the application of our suggestions in other hospitals with the same system may require some adjustment, different triage systems will require individual assessments and specific adjustments. Furthermore, our results are from an 18-month period after implementation. Despite the presence of the reference card for everyday use, it would be advisable to evaluate whether the effect of our intervention remains in force after a longer period.

Finally, we believe that anaphylaxis guidelines should include the role of triage as the first step in treatment of this condition in health centers and hospitals. We need to be aware that no emergency department physician will be able to care for a patient with anaphylaxis sufficiently quickly without proper prioritization on admission to the ED.

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Conflicts of Interest

The authors declare that they have no conflicts of interest.

Previous Presentation

Partial preliminary results from this study were presented at poster sessions during the Second European Pediatric Resuscitation and Emergency Medicine Conference (PREM), held in Ghent, Belgium in May 2017, and at the Spanish Allergy and Clinical Immunology Society Meeting (SEAIC) held in Murcia, Spain in October 2017 (Simposio Internacional Aerobiología, contaminación y cambio climático).

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