Agreement between Prehospital and Final Diagnosis in Patients with Acute Allergic Reactions: A Cross-Sectional Study

Saeed Golfiroozi[1], Nader Tavakoli[1*], Peyman Namdar[2]
and Mohammad Amin Zare[1]

[1]*Emergency Medicine Department, Iran University of Medical Sciences, Trauma and Injury Research Center, Tehran, Iran.*
[2]*Emergency Medicine Department, Qazvin University of Medical Sciences, Tehran, Iran.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

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ABSTRACT

Introduction: Acute allergic reactions are usually first encountered in the prehospital setting and account for about 0.3% to 0.8% of prehospital runs in different countries. Right, and rapid recognition and treatment are necessary to decrease mortality and morbidity, especially in severe critical cases. This study evaluates the accuracy of prehospital care providers' diagnosis in patients with acute allergic reactions in comparison with final (discharge) diagnosis as the gold standard.
Methods: Patients who were transported to 2 urban referral hospitals between 2008 and 2014 under the dispatch code of "acute allergic reaction" were included in the study, retrospectively. Demographic data, etiology of an allergic reaction, clinical presentations, vital signs stability, and need for epinephrine injection were evaluated. The prehospital care providers' diagnosis (documented on-call report) was compared with the final diagnosis (documented on discharge summary form).
Results: A total of 300 patients were included in the study. In 55 (18.3%) cases the prehospital care providers' and final diagnoses were different. Diagnoses were similar in 245 (81.6%) patients.

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*Corresponding author: E-mail: marziehfathi@yahoo.com;

Kappa coefficient was calculated as 0.621which shows a moderate-to-substantial agreement between prehospital and final diagnoses. Fifteen patients (5%) were discharged from the hospital with a diagnosis of anaphylaxis and only 4 cases (26.6%) were diagnosed in the prehospital setting.

Conclusion: Although the overall agreement between prehospital and final diagnosis of acute allergic reactions calculated in this study was good, the accuracy of diagnosing the anaphylaxis (as the most critical allergic reaction with a potential fatality) was less than optimal.

1. INTRODUCTION

Acute allergic reactions are usually first encountered in the prehospital setting. Right, and rapid diagnosis and treatment are necessary to decrease mortality and morbidity, especially in severe critical cases. More accurate prehospital diagnosis will result in improved prognosis in patients with potentially life-threatening conditions by decreasing the time-to-treatment especially in cases of anaphylaxis.

Anaphylaxis (a severe systemic immediate-type hypersensitivity reaction) is the most serious allergic reaction which may lead to death rapidly due to upper and lower airway obstruction, severe hypotension and vascular collapse, and cardiac dysrhythmias [1]. Although it is considered as a differential diagnosis in any patient with unexplained hypotension or respiratory distress, diagnosis of anaphylaxis can be problematic in a prehospital situation.

This study evaluates the accuracy of prehospital care providers' diagnosis in patients with acute allergic reactions in comparison with final (discharge) diagnosis as the gold standard.

2. METHODS

2.1 Study Design and Setting

This retrospective cross-sectional double-center study was conducted in 2 tertiary level teaching hospitals with a total annual census of 90,000 patients between March 2008 and March 2014.

2.2 Participants and Procedure

We used the census sampling method and enrolled all patients who were transported to the hospital by emergency medical services (EMS) under the dispatch code of "acute allergic reaction". This primary impression was made by the dispatch physician based on the reported history and clinical presentations. Dispatch physicians considered any new generalized skin rash, respiratory distress, cardiovascular compromise, gastrointestinal manifestations, or neurological deficits in patients suspicious to encountering a new trigger allergen like a drug as alarm signs and symptoms of acute allergic reactions. Although asthma has also an allergic base from a pathophysiologic point of view, cases suspicious to have asthma attacks are categorized separately under the code of "asthma attack" in the Iranian EMS dispatch system and were excluded from the study automatically.

All patients were transferred by the ambulances with first-aid personnel on board (without any physicians or paramedics).

We reviewed the medical records of patients and gathered the data about the demographic characteristics, stability/instability of patients' vital signs in first prehospital assessment, use of epinephrine administration by EMS staff, the most probable cause of the allergic reaction, prehospital diagnosis (diagnoses documented on-call report by EMS staff) and final diagnosis (diagnosis documented on discharge summary form by hospital physicians). Documented diagnoses were categorized as urticaria, angioedema, anaphylaxis, drug allergy, gastrointestinal (GI) allergy, allergic reactions due to insect bites, and other types of allergic reactions. We excluded patients whose medical records were not comprehensive or reliable.

2.3 Data Analysis

Descriptive continuous numerical data are presented as a minimum, maximum, and mean (with standard deviation). Descriptive categorical variables are described as absolute and relative (percentage) frequencies. The agreement between prehospital and final diagnosis is evaluated by Cohen's weighted Kappa coefficient. All data analyses are performed with SPSS version 18 (SPSS, Inc., Chicago, IL, USA).

3. RESULTS

According to our inclusion criteria, 317 patients were eligible to enroll in the study. Medical records were not comprehensive in 17 cases. At last 300 patients were included and analyzed. The mean annual rate of transportation of patients with an acute allergic reaction to studied hospitals was 21.42 between 2008 and 2014.

Basic characteristics- From 300 included patients, 170 (56.66%) were female and 130 (43.33%) were male. The mean age was 41.86 (±17.22) years old with a minimum of 3 and a maximum of 90 years old. Eleven (3.66%) patients were under 18 years old and 33 (11%) were above 65 years old. In 261 (87%) of cases, calls came from patients' homes and the caller was the patient himself or a family member. In 39 (13%) cases calls came from medical/dentistry offices or clinics, workplaces, public places, or outdoor environments. Thirty (10%) of studied patients had a known previous history of allergy (7 drug allergies, 23 food allergies). One (0.33%) patient, a 63 years old woman, was under preventive treatment with oral anti-histamines because of multiple previous allergic attacks. Fourteen (4.66%) patients had a positive family history of allergy (2 drug allergies, 12 food allergies).

Clinical presentations- The most common clinical presentations reported to dispatch physicians and documented by EMS staff and/or emergency physicians were skin rash/erythema in 258 (86%), pruritis in 249 (83%), palpitation in 38 (12.66%), face and neck swelling in 25 (8.33%), acute cough with/without respiratory distress in 34 (11.33%), GI symptoms in 7 (2.33%), generalized weakness in 1 (0.33%), loss of consciousness in 1(0.33%), seizure in 1 (0.33%).

Vital signs in prehospital setting- Vital signs were stable in 289 (96.3%) patients and unstable in 11 (3.66%) patients in the prehospital setting. According to their medical reports, 7 of these 11 (63.63%) unstable patients had anaphylaxis, 2 (18.18%) had severe angioedema and 2 (18.18%) had severe generalized urticaria. The oldest patient with unstable vital signs was a 65 old woman with an anaphylactic reaction to peanut and the youngest one was a 23 years old man with a reaction to intramuscular penicillin injection. Other allergens in this group were amoxicillin, sumatriptan, lidocaine, hair decolorizing powder, strawberry, and oatmeal.

Epinephrine injection- Twenty-four (8%) of 300 patients received prehospital epinephrine injection. Indication of administration was documented as severe generalized urticaria in 12 (50%) patients, severe angioedema in 7 (29.16%) patients, and anaphylaxis in 5 (20.83%). In 8 (33.33%) patients epinephrine injection was due to vital sign instability and 16 (66.66%) of these 24 patients had stable vital signs in the prehospital setting while receiving the injection.

Presumed cause of reaction- In 217 (72.33%) cases, the presumed cause of allergic reaction was unknown (idiopathic allergic reaction). In other 83 (27.67%) cases, most probable cause of reaction was: drug in 61 (20%), food in 10 (3%), decolorizing powder in 6 (2%), insect bite in 1 (0.33%) and cold in 1 (0.33%).

The most common drugs inducing allergic reactions were beta-lactam antibiotics (specifically intramuscular penicillin and amoxicillin) and analgesics especially non-steroidal anti-inflammatory drugs (NSAIDs) (Table 1). Two cases had used multiple drugs simultaneously. Peanut, strawberry, oatmeal, seafood, fast food, sesame, and walnut were food allergens presumed as the cause of reaction in our studied patients (Table 2). There were 4 (1.33%) cases of insect bites (2 cases of wasp stings, 1 centipede, and 1 unknown insect). In a 17 years old girl the most probable cause of severe urticarial reaction was cold weather.

Anaphylaxis etiology was drug in 6 (40%), food in 5 (33.33%), wasp sting in 1 (6.66%), decolorizing powder in 1(6.66%) and idiopathic in 2 (13.33%) cases. Penicillin, amoxicillin, methocarbamol, ibuprofen, peanut, strawberry, seafood, sesame, and walnut were the most probable presumed allergen in these cases.

Agreement between diagnoses- There was an agreement between prehospital and final diagnosis in 245 (81.66%) of 300 studied cases transported to the hospital with a primary impression of acute allergic reaction. Kappa coefficient was calculated as 0.621 in our study (Table 3).

The maximum agreement was seen in patients with an insect bite, GI allergy, and urticaria.

Table 1. Drugs presumed to induce an allergic reaction in studied patients

Drug	Frequency	Percentage
Penicillin	12	4
Amoxicillin	8	2.6
Local anesthetics	7	2.32
Ibuprofen	7	2.32
Diclofenac	3	0.99
Mefenamic acid	2	0.66
Cephalexin	2	0.66
Multi-drug	2	0.66
Cefixim	1	0.33
Ciprofloxacin	1	0.33
Levofleoxacin	1	0.33
Co-amoxiclav	1	0.33
Indomethacin	1	0.33
Metocarbamol	1	0.33
Botulinum toxin (BOTOX)	1	0.33
Hyoscine	1	0.33
Nortriptyline	1	0.33
Iron (IV)	1	0.33
Somatriptan	1	0.33
Interferon	1	0.33
Salbutamol (spray)	1	0.33
Zolpidem	1	0.33
Body building supplements	1	0.33
Traditional medicine	1	0.33
Ketoconazole	1	0.33
Pethidine	1	0.33
Total	61	20.3

Table 2. Presumed etiologies of allergic reaction in studied patients other than drug

	Name	Frequency	Percentage
Idiopathic	-	217	72.33
Food	Peanut	1	0.33
	Strawberry	1	0.33
	Seafood	1	0.33
	Walnut	2	0.66
	Sesame	1	0.33
	Oatmeal	1	0.33
	Fastfood	1	0.33
	Peas	1	0.33
	Spices	1	0.33
	Total	10	3
Chemical/cosmetics	Decolorizing powder	6	1.98
	Cosmetics	1	0.33
	Total	7	2.33
Insect bite	Wasp	2	0.66
	centipede	1	0.33
	unknown	1	0.33
	Total	4	1.33
Environmental	cold	1	0.33

Table 3. Agreement between prehospital and final diagnoses*

Diagnosis		Final diagnosis							
		Urticaria	**Drug allergy**	**Angioedema**	**Anaphylaxis**	**Insect bite**	**GI allergy**	**Others**	**Total**
Prehospital	Urticaria	191	23	9	6	0	0	5	224
diagnosis	Drug allergy	1	31	0	2	0	0	0	34
	Angioedema	0	0	7	1	0	0	0	8
	Anaphylaxis	0	0	1	4	0	0	0	5
	Insect bite	0	0	0	1	3	0	0	4
	GI allergy	0	0	0	0	0	3	0	3
	Others	0	0	0	1	0	0	7	12
	Total	192	58	17	15	3	3	12	300
	Percentage of agreement	99.47	53.44	41.17	26.66	100	100	58.33	

*Kappa is calculated as 0.621

As 192 of 300 (64%) studied patients were discharged from the hospital with the final diagnosis of urticaria and in 191 of them (99.47%), the prehospital diagnosis was also urticaria. A minimum agreement was seen in patients with anaphylaxis as 11 of these 15 (73.33%) patients were diagnosed as urticaria, angioedema, drug allergy, and respiratory allergy cases instead of anaphylaxis. In cases with the final diagnosis of drug allergy, the prehospital and final diagnosis was the same in 31 (53.44%) patients. Twelve cases who were transported to the hospital with a primary diagnosis of acute allergic reaction were diagnosed to have systemic diseases and discharged with final diagnoses like hepatic encephalopathy, pneumonia, tuberculosis, rheumatologic disease, sepsis, foreign body aspiration, and drug poisoning.

4. DISCUSSION

Allergic reactions account for about 0.3% to 0.8% of prehospital runs in different countries [2,3] and need prompt attempts for recognition and treatment in the prehospital setting because of potential fatality in some cases. Accurate diagnosis is a critical step in the prehospital care of these cases.

In our study etiology of allergic reactions was unknown in about 70% of cases. This may be due to insufficiencies in history taking or documenting the data or recall bias in patients. In cases with the identified presumed cause of allergy, drugs were the most common cause (20%). This is compatible with other studies in this field which show that oral medicines are the most common causes of allergy [4]. Penicillin is at the top of our list of allergens inducing severe reactions. This is compatible with the results of an epidemiologic study in the United States which shows that penicillin, radioactive contrasts, and insect stings are the most common causes of anaphylaxis over there [5]. Other studies also verify our results by showing that penicillin is the most common cause of drug-induced anaphylaxis with great cross-reactivity to first-generation cephalosporins like cephalexin followed by NSAIDs [6-11]. Local anesthetics were an important percentage of drug-induced allergic reactions in our study. Other studies show that allergy to local anesthetics is rare (representing only 1% of all adverse reactions to medications) [12]. It should be noticed that dental procedures are not desirable for most people and they may exhibit some presentations like tachycardia, generalized weakness, difficulty in breathing, sweating, or even syncope which are due to sympathetic discharge and should not be mistaken with signs and symptoms of allergic reactions [13,14].

By considering the discharge diagnosis as the gold standard, our study showed that Iranian EMS staff can recognize most cases of acute allergic reactions accurately. Kappa coefficient is 0.621 in our study which means that there is a moderate-to-substantial agreement between prehospital and final diagnosis in patients transported to studied hospitals under the dispatch code of acute allergic reaction (Cohen suggested the Kappa result be interpreted as follows: values ≤ 0 as indicating no agreement and 0.01–0.20 as none to slight, 0.21–0.40 as fair, 0.41– 0.60 as moderate, 0.61–0.80 as substantial, and 0.81–1.00 as almost perfect agreement) [15,16].

This is contrary to the results of limited other studies which are done in the prehospital setting [17,18]. One of the most important studies published in this field is the study of Godet-Mardirossian et al in which 210 calls for acute allergic reactions in Paris were followed up and agreement between initial diagnosis made by dispatching physicians and final diagnosis and initial and final severity assessment results were evaluated. In this study, there was a low to moderate correlation between initial diagnosis and severity assessment of acute allergic reactions by dispatching physician and the final diagnosis and severity as the diagnoses were the same only in 54% of cases. The severity of reaction was also underestimated in about 22% of patients (Kappa=0.44) [19]. In another study by Besnier et al who compared the agreement of diagnosis and severity assessment in all medical conditions, it was shown that there is a low correlation between dispatching and final diagnosis (52%) and severity assessment (14.4%) in patients transported to hospitals by EMS [20]. This low agreement rate especially in comparison with our study in which the diagnosis of basic level prehospital care providers was evaluated can be due to the short time dispatching physicians have to obtain clinical information, make a decision, and initiate the best response for the patient.

Although a high agreement rate between prehospital and final diagnosis is a promising finding in our study it should be noticed along with a more important issue which is low

accuracy in the prehospital diagnosis of anaphylaxis cases. As our study results show only 4 of 15 (26.6%) anaphylaxis cases were recognized by EMS staff. Because of the proven role of delays in epinephrine administration in increasing the mortality rate in different cases of anaphylaxis with different causes of reaction [21-25], this finding makes concerns in this era. It seems that in charge liable organizations should survey to evaluate the situation more precisely and find the bottlenecks in diagnosing the anaphylaxis process in the prehospital setting. The most common challenges in approaching the patients with anaphylaxis in the prehospital setting are the diversity of clinical presentations; lack of standard case definitions, diagnostic criteria, and management protocols [26]; dependency on the diagnosis and severity assessment by dispatching physicians, and issues in epinephrine administrations [27-29]. Regular international symposiums are conducted to find a comprehensive definition and provide practical diagnostic criteria for everyday use in both prehospital and hospital approaches to patients with anaphylaxis [30]. Retrieving the products of these symposiums and providing consolidated efficient educational programs may help EMS staff to identify the alarm signs and symptoms more accurately in patients with anaphylaxis.

5. CONCLUSION

Although the overall agreement between prehospital and final diagnosis of acute allergic reactions calculated in this study was good, the accuracy of diagnosing the anaphylaxis (as the most critical allergic reaction with a potential fatality) was less than optimal.

6. LIMITATIONS

Small sample size, inconsistency between the range of EMS staff knowledge and experience, lack of standard definitions for different allergic reactions, and a considerable number of cases with unknown etiology are some of the limitations in our study.

DISCLAIMER

The products used for this research are commonly and predominantly used products in our area of research and country. There is no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by the personal efforts of the authors.

CONSENT

It is not applicable.

ETHICAL APPROVAL

The study was approved by the institutional ethics committee (faculty of medicine, Iran University of Medical Sciences) and carried out following the Declaration of Helsinki (1989).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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