A pharmaceutical case report on hypersensitivity reaction following insect sting

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ABSTRACT

Hypersensitivity reactions from insect sting can be a severe sometimes life-threatening episode. A case of allergic reaction in a 7-year-old child following a bee sting is reported. Pharmaceutical interventions and emergency care approach with follow-up included administering epinephrine before further evaluation and management was implemented with post-medication observation. A 2h post-attention assessment revealed a positive outcome while a next day appointment visit revealed a stable child. Pharmaceutical comprehensive allergy assessment, prompt attention resolved allergic episodes an indication of a positive outcome.

KEYWORDS: Allergic reaction, Insect sting, Epinephrine, Allergy, Pharmaceutical intervention

INTRODUCTION

Most allergic reactions happen after contact with an allergen. Many reactions are mild while others can be life threatening [1]. In children, insect stings are a common trigger for allergic reactions. Prompt recognition and treatment are crucial to prevent morbidity and mortality [2]. We present a case of allergic reaction in a child following an insect sting and detailing of the clinical presentation, management, and follow-up care are scarce in the literature.

Allergic reaction represents a severe allergic response marked by systemic manifestations affecting the respiratory, cardiovascular, cutaneous, and gastrointestinal systems [3]. Among children, insect stings serve as frequent instigators of this life-threatening condition. Timely identification and intervention play pivotal roles in averting adverse outcomes [4]. Herein, we illustrate a case of allergic reaction precipitated by an insect sting in a pediatric client, elucidating the clinical manifestation, therapeutic approach, and subsequent monitoring strategies [5]. Through this case study, we aim to underscore the significance of rapid recognition and appropriate management in mitigating the morbidity and mortality associated with allergic reaction in children, thereby advocating for heightened vigilance and comprehensive care in such scenarios.

METHODOLOGY/OBSERVATIONS

Nature of Encounter

A 2-visit encounter and pharmaceutical case study of a 7-year old female child with hypersensitivity reaction following an insect sting is reported.

Medical History

The client, BM a previously healthy child, presented to the pharmacy with an incidence of a bee sting on the left forearm approximately 30 minutes prior to arrival. There was no previous history of allergy to insect stings or other known allergies.

Medication History

Drug intake history of the client has been unremarkable, being a healthy child having observed all the protocols of early childhood immunization protocols.

History of Present Illness

The client developed immediate symptoms of allergic reaction shortly after the bee sting, including generalized urticaria, facial swelling, difficulty in breathing and wheezing.

Current Complaint and Presentation

Upon presentation, the client was in distress, with stridor and decreased air entry bilaterally.

Other Diseases/Co-Morbidity

The client has no other significant diseases or co-morbidities.

Familial and HEAD-SU

There is no family history of allergies or allergic reaction. The client's maternal uncle has asthma, while the paternal side has a history of hypertension and diabetes. No known history of epilepsy, sickle cell anaemia, or other significant diseases.

Surgical History

The child has not undergone any surgical procedures

Allergies

The client has no known allergy to drug, food or insect stings

Client's Current Medications

Synthetics

The client is not currently taking any medications and has just reported to the pharmacy for this episode

Natural products

The client is not currently taking any natural medications.

Client's Nutritional Intake

Special intake

No special meal type adopted

Regular intake

The client's nutritional intake includes a balanced diet consisting of fruits, vegetables and whole grains. They consume a variety of foods rich in vitamins and minerals to support overall health and well-being.

Occasional intake

The client takes yoghurt and other diary products only occasionally, due to perceived resultant stomach discomfort .

Client's Lifestyle

Professional

The client is a student.

Social

The client leads an active lifestyle, as a pupil, she engages in regular physical exercise, such as walking and cycling.

Religious

She practices the Christian fate along with her parent's disposition.

Social and Family History

The client resides in a supportive family environment with no history of allergies or significant medical

conditions among family members. Socially, the child interacts well with peers and participates in age-appropriate activities.

Physical Examination

Vital signs

The following are the details of client's vitals: Blood pressure 80/50 **(90-110/70-80);** Respiration rate 97 cycles/min **(55-90);** Pulse 140 beats per min **(50-90);** Temperature 37.4ºC **(36.1-37.2),** Body weight 36 Kg **(20-42).**

General Examination

The client appeared anxious and dyspneic, with diffuse urticaria and facial swelling. The client's condition showed marked deteriorated, requiring immediate care and intervention.

Cardiovascular Examination

An evident tachycardia with low blood pressure was observed in the client

Respiratory Examination

Widespread wheezing and decreased air entry due to chest tightness

Gastrointestinal Examination

Rapid movement of the abdominal muscles observed

Laboratory Investigations: (Pharmacist-ordered)

Imaging tests

None was recommended or performed

Biochemical tests

Serum tryptase levels 20 ng/ml **(25)**, Complete blood count (WBC; RBC; Hb; Differential), WBC 10,000cells/µl **(4,800-10,800**), RBC 3.5million cells/µl **(4.0–5.5),** Hb 12g/dl **(12-16),** (Neutrophils 53% **(40-60%),** Eosinophils 1.5% **(1-4%),** Basophils 1% **(0.5-1%),** Lymphocyte 38% **(20-40%),** Monocytes 6.5% **(2-8%)** and serum electrolytes: Sodium 101mmol/L **(136-144);** Potassium 4.9 mmol/L **(3.7-5.1);** Calcium 9.8 mg/dL **(8.5-10.2);** Chloride 86 mmol/L **(97-105);** Magnesium 1.9mg/dL **(1.7-2.2);** Phosphorus 3.4 mg/dL **(2.5-4.8);** Bicarbonate 27mmol/L **(22-30).**

Microbiological tests

None was recommended or performed

Pharmaceutical Audits:

Drug - Disease Audit

Client is currently not on any drug

Drug- Drug Audit

There is no previously administered drug to review for the client

Drug-Food Audit

There is no previously administered drug to review for

Drug-Laboratory Test Outcome Audit

There is no previously administered drug to review for possible drug –laboratory test outcomes for this client

Drug-Lifestyle Audit

No audits performed as there was no previous drug list or prescription.

Decision to Dispense/Refill or otherwise of drugs a. Dispense/Refill- reasons and b. Hold back-reasons

Not applicable

Pharmaceutical Intervention (Reasons for Interventions/Suggestion for resolution

Not applicable

Pharmaceutical Care Goals

To resolve the medication-related problem

Pharmaceutical Care Plans

Identify the problem or risk involving medication or disease state. List medication related problems in order of priority. Specify the therapeutic goals for each medication-related problem identified. List anticipated outcomes. Monitoring requirements and further action, if necessary

Ensuing Drug Recommendation/Prescription

Epinephrine inj from 1mg/ml, a dose of 0.05mg/kg was administered and repeated after 30 min as IM route, as needed

Levocetirizine 5mg tablet once daily x 5 days

Hydrocortisone 100 mg intravenously twice daily x 5 days.

DISCUSSION

Biopharmaceutics and Pharmacology

Epinephrine

Epinephrine stimulates alpha and beta adrenergic receptors, leading to bronchodilation, vasoconstriction, and increased cardiac output. It counteracts the vasodilation and increased vascular permeability seen in allergic reaction. No significant drug interactions with epinephrine were identified. Epinephrine injection is indicated in the emergency treatment of type I allergic reactions, including anaphylaxis. It is also used to increase mean arterial blood pressure in adult clients with hypotension associated with septic shock [6-8].

Epinephrine's cardiac effects may be of use in restoring cardiac rhythm in cardiac arrest due to various causes but is not used in cardiac failure or in hemorrhagic, traumatic, or cardiogenic shock. Epinephrine is used as a hemostatic agent. It is also used in treating mucosal congestion of hay fever, rhinitis, and acute sinusitis; to relieve bronchial asthmatic paroxysms; in syncope due to complete heart block or carotid sinus hypersensitivity; for

symptomatic relief of serum sickness, urticaria, angioneurotic edema; for resuscitation in cardiac arrest following anesthetic accidents; in simple (open angle) glaucoma; for relaxation of uterine musculature and to inhibit uterine contractions. Epinephrine injection can be utilized to prolong the action of local anesthetics [9].

In addition to the above, epinephrine is used as an over the counter (OTC) agent for the intermittent symptoms of asthma, such as wheezing, tightness of chest and shortness of breath. It is also used for the maintenance of mydriasis during intraocular surgery. Epinephrine acts on alpha and beta-adrenergic receptors. Epinephrine acts on alpha and beta receptors and is the strongest alpha receptor activator [10]. Through its action on alpha-adrenergic receptors, epinephrine minimizes the vasodilation and increased the vascular permeability that occurs during anaphylaxis, which can cause the loss of intravascular fluid volume as well as hypotension. Epinephrine relaxes the smooth muscle of the bronchi and iris and is a histamine antagonist, rendering it useful in treating the manifestations of allergic reactions and associated conditions. This drug also produces an increase in blood sugar and increases glycogenolysis in the liver. Through its action on beta-adrenergic receptors, epinephrine leads to bronchial smooth muscle relaxation that helps to relieve bronchospasm, wheezing, and dyspnea that may occur during anaphylaxis [11]

Following I.V. (intravenous) injection, epinephrine disappears rapidly from the blood stream. Subcutaneously or I.M. (intramuscular) administered epinephrine has a rapid onset and short duration of action. Subcutaneous (SC) administration during asthmatic attacks may produce bronchodilation within 5 to 10 minutes, and maximal effects may occur within 20 minutes. The drug becomes fixed in the tissues rapidly

Epinephrine is rapidly inactivated mainly by enzymic transformation to metanephrine or normetanephrine, either of which is then conjugated and excreted in the urine in the form of both sulfates and glucuronides [12]. Either sequence results in the formation of 3-methoxy-4- hydroxy-mandelic acid (vanillylmandelic acid, VMA) which is shown to be detectable in the urine. Epinephrine is rapidly inactivated in the body mostly by the enzymes catechol-O-methyltransferase ((COMT)) and monoamine oxidase (MAO). The liver is abundant in the above enzymes, and is a primary, although not essential, tissue in the degradation process [13]

Levocetirizine

The drug blocks histamine receptors, particularly H1 receptors, reducing symptoms such as itching, hives, and nasal congestion. They do not interfere with the action of epinephrine but may cause drowsiness when used concomitantly [14].Levocetirizine hydrochloride (hereafter, levocetirizine) is one of the two enantiomers (R-enantiomer: levocetirizine, S-enantiomer: dextrocetirizine) of cetirizine hydrochloride (hereinafter, cetirizine). Levocetirizine is classified as a second generation antihistamine and is available for the treatment of allergic disorders, such as allergic rhinitis and chronic idiopathic urticaria [15, 16].

The antihistaminic activity of cetirizine is primarily due to levocetirizine, which has high affinity and selective antagonistic activity against histamine (H_1) receptors and inhibits eosinophil chemotaxis. A large number of clinical studies have demonstrated the efficacy, tolerability, long-term safety, and patient satisfaction of levocetirizine. Levocetirizine has been reported to be rapidly and extensively absorbed following oral administration of levocetirizine 5 mg and 10 mg as a tablet formulation in healthy Japanese male subjects, where time to reach the maximum concentration (t_{max}) was achieved between 0.8–1 h after administration and declined with the terminal half-life ($t_{1/2}$) of 7.3–7.6 h. Levocetirizine is eliminated predominantly by renal excretion, with limited metabolism [17-19].

Hydrocortisone

Suppress inflammation and immune responses by inhibiting the production of inflammatory mediators. They are used as adjunctive therapy to prevent biphasic reactions and reduce inflammation in allergic reaction. No significant drug interactions with epinephrine were identified [20, 21]

Hydrocortisone, also known as cortisol, is a short-acting glucocorticoid. After oral administration, hydrocortisone is readily absorbed with a biological half-life of approximately 1.0–1.5 h before metabolism by the liver. The reduction of the 3-keto and 4,5-double bond of A ring by 5β-reductase and 3α/β-hydroxysteroid dehydrogenase, respectively, results in the formation of inactive metabolites. The excretion of hydrocortisone mainly occurs through the urine as urocortisol, cortisone, and glucuronic acid/sulfate conjugates of 5β-dihydrocortisol. Hydrocortisone is therapeutically used as a replacement therapy for acute/chronic adrenal insufficiency, status asthmaticus, and shock. In addition to its anti-inflammatory and blood pressure stabilizing effects, hydrocortisone has been shown to decrease oxidative stress, increase the levels of extracellular superoxide dismutase (ECSOD), and decrease PDE5 activity [18, 19].

The bioavailability (F) of hydrocortisone is high (0.95), and the maximum cortisol concentration (C_{max})

and area under the cortisol concentration-time profile (AUC) of hydrocortisone are dose-dependent in the clinically relevant doses after both intravenous (iv) and oral administration [20]. The PK of hydrocortisone in pediatric patients with CAH has mostly been characterized with less sophisticated PK approaches [21]. The versatile population PK approach has rarely been applied to simultaneously understand the typical PK behavior of the population, the associated variability between and within patients, as well as the influence of demographic or other relevant patient factors [22].

In healthy children, the hypothalamo-pituitary adrenal (HPA) axis regulates the glucocorticoid cortisol, and indirectly the adrenal androgens, with a negative feedback inhibition loop. The circadian rhythm of cortisol is generated in turn by the central hypothalamic circadian clocks. In the absence of this negative feedback in patients with 21-hydroxylase deficiency, one of the cortisol precursors, 17-hydroxyprogesterone (17-OHP), is elevated and is commonly used as a biomarker for hydrocortisone therapeutic success. Mimicking the circadian rhythm of cortisol in CAH patients should result in physiological feedback and a beneficial treatment outcome [23].

Pharmacist's subsequent Assessment

During the first follow-up visit, the client's response to the newly initiated drugs was evaluated. Additionally, any adverse effects or unexpected outcomes were documented for further evaluation and management.

Comment/Laboratory Outcome

The laboratory results revealed a positive response to the treatment regimen, with improvement in relevant parameters such as inflammatory markers, allergic response indicators, and overall clinical status. Any notable findings or deviations from expected outcomes were carefully analyzed and addressed accordingly.

Client's Self-Evaluation Report

Client reported that the previously experienced condition had shown relief progressively

Non-Pharmacological Advice:

Lifestyle counseling

Avoiding of contact with insect by wearing protective clothing and using insect repellents will reduce futre events.

Education on recognizing early signs of allergic reaction and seeking prompt medical attention will facilitate quicker intervention

Monitoring parameters for progress

There was no need for monitoring of progress of the ailment as the condition was progressively and positively resolving.

Seeking Medical Advice/Attention

There was no need to seek further medical attention for the client as the condition abated as expected timeously

CONCLUSION:

Allergic reaction following an insect sting is a potentially life-threatening condition that requires prompt recognition and treatment. This case underscores the importance of timely intervention, appropriate use of epinephrine, and comprehensive allergy assessment to prevent future episodes and improve client outcomes.

ETHICAL CONSIDERATIONS

Data Availability

Request for further data on the case study can be obtained from the correspondence author

Conflict of Interest:

No conflict of interest is declared by the author.

Compliance with Ethical Guidelines

Approval for this study and related cases was obtained from the University of Uyo Health Research Ethics Committee

Authors' contributions

The authors confirm contributions as follows: study conception and design by EEV and AUM; data collection by AUM; Analysis and interpretation of results by SMN and ASO; Draft manuscript preparation by EEV; All authors reviewed the result and approved the final version of the manuscript

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