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Neurocognitive manifestation after treatment of pediatric severe anaphylaxis

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Abstract

Background Anaphylaxis is a common, severe, and life-threatening allergic reaction that occurs rapidly after exposure to an allergen which can affect multiple systems in the body. In rare cases, it may lead to additional neurological manifestations that are poorly understood.

Case presentation We present a case of a 14-year-old boy who experienced severe anaphylaxis necessitating airway intervention and admission to critical care. While his initial presentation and treatment aligned with current standards, he subsequently developed prolonged neurological deficits, including weakness, prosopagnosia, amnesia, and loss of basic functions, during an extended recovery period.

Conclusion This rare neurological manifestation following anaphylaxis may be overlooked by many clinicians. Therefore, it is imperative to highlight this potential complication to improve the management of patients experiencing anaphylaxis.

Keywords Anaphylaxis, Amnesia, Allergy

Background

Anaphylaxis is a life-threatening type-1 hypersensitivity reaction that affects multiple organ systems after exposure to an offending agent, commonly food, insect sting, medication, or other physical factors. Food allergy is the most common allergenic trigger in children [1]. While fatalities are rare, acute presentations can progress rapidly to cardiovascular and respiratory arrest. Because the clinical course of anaphylaxis can be unpredictable, prompt and early treatment is required to decrease morbidity and mortality. Much of our understanding of potential clinical manifestations after aggressive treatment is unknown [2]. Our case presentation describes a rare neurologic complication after food-related anaphylaxis in a pediatric patient. Consent for the publication of this case report was obtained from the patient and legal guardian.

Case presentation

A 14-year-old male with a known history of allergy to cashews presented to the emergency department with difficulty breathing. His mother brought him to the ED within 30 min of the onset of symptoms. Symptoms began after the patient ate some dessert consisting of "mini chocolate drizzled croissants". One hour after eating about 4 to 5 croissants, he complained of tongue swelling without any respiratory distress. Mom treated the patient immediately with intramuscular epinephrine, Benadryl, and 4 puffs of Albuterol metered dose inhaler (MDI) without any relief. The epinephrine was repeated 5 min after the initial dose. The patient was then taken to the emergency department after he became nauseous

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and began drooling with increased work of breathing. Before arriving to the ED, he became stridulous and subsequently lethargic. On presentation, he was afebrile and tachycardic with the following vital signs: Temperature 36.9 C; Heart rate 151 beats per minute; Respiratory rate 18 breaths/minute; Blood Pressure 162/99 mmHg; SpO2 100% on 100% O2 non-rebreather. He had severe stridor, was tachycardic, and tachypneic, with poor air movement bilaterally. He also had mild oral edema. He was given another dose of epinephrine, and the decision was made to intubate the patient for severe anaphylaxis before transferring to a pediatric tertiary care hospital for further management. Initial labs were unremarkable except for potassium point-of-care, which was 2.5 mmol/L and repleted before transfer. The chest radiograph was reassuring. He was transferred on continuous propofol and epinephrine. It is unclear how long it took for the patient to arrive at the ED, though the estimated distance from the initial evaluation site is about 15 min. Upon arrival, the patient was re-evaluated in the ED and admitted to the critical care unit.

The patient was extubated the following day and subsequently discharged. His neurologic status was normal at the time of discharge. No initial neuroimaging was performed before discharge. The patient's post-discharge neurologic symptoms were initially thought to be due to his hemodynamic presentation, but this persisted and worsened over time. Subsequently, no imaging was ordered by the neurologist during the post-discharge evaluation. He was initially debilitated with confusion and some memory loss. Post-discharge, he regained his physical strength, but his confusion and ability to recall persisted. The patient exhibited frequent agitation, fatigue, anxiety, and decreased awareness of his surroundings. He could not remember the name or location of his school and perform simple tasks such as using the phone or playing video games. He often exhibited sensory sensitivity to screens and had difficulty recognizing familiar faces, including friends and family members. The patient did not receive any therapeutics post-discharge other than frequent follow-up with his neurologist. Over time, he formed new memories and was able to recall past events. The patient's agitation had improved. One year after he presented with severe anaphylaxis, the patient continues to have memory deficits and occasional confusion, but he is now closer to his baseline before the diagnosis. The patient was seen by a neurologist, who supportively managed his symptoms.

Discussion/conclusion

Anaphylaxis is a life-threatening, systemic hypersensitivity reaction and the most severe form of allergic reaction. This is a systemic response to a specific allergen and usually occurs acutely after exposure [3]. In children, food-related reactions are most common, mediated by immunoglobulin E (IgE) leading to mast cells and basophils activation and degranulation. Other common mediators released as a result of the reactions include histamine, heparin, tryptase, kallikrein, platelet-activating factor, bradykinin, tumor necrosis factor, nitrous oxide, interleukins, and other pro-inflammatory cytokines [4]. Manifestations can include neurological responses, which occur about 15% of the time, patients may exhibit headache, dizziness, lightheadedness, confusion, tunnel vision, and loss of consciousness. Prompt intramuscular epinephrine administration is the therapy of choice, along with ensuring proper oxygenation and circulation [5]. In severe cases, as noted in this case, the patient may require advanced airway and continuous infusion of epinephrine to enhance vasoconstriction, increase peripheral resistance, decrease mucosal edema, increase cardiac inotropy/chronotropy, and bronchodilation to reverse the airway obstruction [6].

While complications of anaphylaxis can affect most systems, neurological manifestation post-anaphylaxis is rare. To our knowledge, this is the first description of such a patient case where memory loss occurred after severe anaphylaxis. A prior case study describing a similar manifestation was reported in an adult patient where memory loss occurred after an insect sting [7]. Similarly, this patient also experienced headaches, disorientation, and an inability to concentrate or to initiate movement [7]. While our patient's weakness was likely associated with the patient's brief hospital stay, his confusion, agitation, and disorientation were persistent for several months after discharge. Since the neurological effects progressively worsened post-discharge, the intensivist believed they were unrelated to the anaphylaxis nor hemodynamic instability en route to the ED. While it's possible these symptoms were related to anesthesia medications, current literature does not describe the effects observed in this case. A proposed pathophysiological explanation, in that case, the report suggested ischemic necrosis of the Carbonic Anhydrase (CA)-1 area of the hippocampus caused by mediators released during the acute event. Our patient did not have any additional imaging after the hospital course nor an EEG to look for changes compatible with neurological deficits. It is important to note that the adult case described showed no changes on MRI but had a nonspecific abnormality in the temporal region [7].

While there were some similarities in the clinical features of both cases, neither could directly associate the ensuing anaphylactic reaction with this neurologic complication post-event and treatment.

Other factors that may have contributed include a sustained inflammatory response, which has been documented in previous studies [8–11]. While anaphylaxis mediators are generally confined to the airways,

cytokines such as Interleukin (IL)-33 may induce an inflammatory state in the central nervous system. IL-33, a member of the IL-1 cytokine family, is described as a key regulator of neuroinflammation [8–11] and is associated with different allergic inflammations such as food anaphylaxis and respiratory allergens. Recent studies suggest that this cytokine is associated with cognitive impairment in the hippocampus [8]. It is not clear whether this could potentially occur in all patients with severe anaphylaxis. Nevertheless, these potential pathways to post-anaphylactic neurological complications should be considered in pediatric patients who present with significant anaphylaxis. Currently, the best approach to the management of this rare clinical sequelae is a consultation with neurology. Further studies to elucidate these factors should be encouraged to further understand the pathophysiology of this neurological post-treatment manifestation to better support patients and their caretakers.

Author contributions

Benjamin Nti MD (Corresponding Author): Reviewed, collected patient information and wrote and prepared the main text of the manuscript. Sheryl Allen MD: Collected patient information from the medical record and Reviewed patient information. She also reviewed the manuscript.

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Data availability

Data is provided within the manuscript.

Declarations

Ethics approval and consent to participate

Consent for medical record review and publication obtained from the patient and parent/ legal guardian.

Consent for publication

Written informed consent was obtained from the patient and parent/legal guardian for publication of this case report.

Competing interests

The authors declare no competing interests.

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References

1. Atanaskovic-Markovic M, Gomes E, Cernadas JR, du Toit G, Kidon M, Kuyucu S, Mori F, Ponvert C, Terreehorst I, Caubet JC. Diagnosis and management of drug-induced anaphylaxis in children: An EAACI position paper. Pediatr Allergy Immunol. 2019;30(3):269–276. https://doi.org/10.1111/pai.13034. PMID: 30734362.
2. Poowuttikul P, Seth D. Anaphylaxis in children and adolescents. Pediatr Clin North Am. 2019;66(5):995–1005. https://doi.org/10.1016/j.pcl.2019.06.005. Epub 2019 Aug 5. PMID: 31466687.
3. Pflipsen MC, Vega Colon KM, Anaphylaxis. Recognition and management. Am Fam Physician. 2020;102(6):355–62. PMID: 32931210.
4. Motosue MS, Li JT, Campbell RL, Anaphylaxis. Epidemiology and Differential Diagnosis. Immunol Allergy Clin North Am. 2022;42(1):13–25. https://doi.org/10.1016/j.iac.2021.09.010. PMID: 34823743.
5. Golden DBK, Anaphylaxis, et al. A 2023 practice parameter update. Ann Allergy Asthma Immunol. 2024;132(2):124–76. https://doi.org/10.1016/j.anai.2023.09.015. Epub 2023 Dec 18. PMID: 38108678.
6. Morriello F, Chapman M. Epinephrine in anaphylaxis. CMAJ. 2023;195(19):E683. https://doi.org/10.1503/cmaj.221319. PMID: 37188369; PMCID: PMC10185359.
7. Mazza J, William M, Gamble BM, Young B. Memory loss and pneumonitis after anaphylaxis due to an insect Sting. CAN MED ASSOCJ1991;144(2).
8. Stone SF, Cotterell C, Isbister GK, Holdgate A, Brown SG. Emergency department anaphylaxis investigators. Elevated serum cytokines during human anaphylaxis: identification of potential mediators of acute allergic reactions. J Allergy Clin Immunol. 2009;124(4):786–e924. Epub 2009 Sep 19. PMID: 19767073.
9. Abd Rachman Isnadi MF, Chin VK, Abd Majid R, Lee TY, Atmadini Abdullah M, Bello Omenesa R et al. Critical roles of IL-33/ST2 pathway in neurological disorders. Mediators Inflamm. 2018;2018:5346413.,Ä®.
10. Du L, Hu X, Yang W, Yasheng H, Liu S, Zhang W, et al. Spinal IL-33/ST2 signaling mediates chronic itch in mice through the astrocytic JAK2-STAT3 cascade. Glia. 2019;67(9):1680–93.
11. Hudson CA, Christophi GP, Gruber RC, Wilmore JR, Lawrence DA, Massa PT. Induction of IL-33 expression and activity in central nervous system glia. J Leukoc Biol. 2008;84(3):631–43.

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