CLINICAL VIGNETTE

A Case of Pancake Shock

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A 34-year-old female presented to Allergy Immunology after an allergic hypersensitivity reaction due to ingestion of pancakes and cherry jam while in Guatemala. She reported consuming home-made pancakes, cherry jam, and a glass of orange juice for breakfast and within minutes, she developed difficulty breathing, a sensation of throat-closing, and diffuse hives. She presented to a local hospital and was treated with 50mg oral diphenhydramine, oral corticosteroids and discharged home the next day. Records from the patient's hospitalization abroad were not available for review and remain irretrievable. The patient reports being told she had a case of "pancake shock". She has since consumed pancakes, cherries, and berries without any adverse reaction. Months following the event, she presents for evaluation of the etiology of her symptoms.

Her past medical history is notable for childhood asthma, chronic rhinitis alleviated with oral loratadine and montelukast. She also has a history of shellfish allergy. She was first diagnosed with a shellfish allergy at age 7 when she developed anaphylaxis. She described difficulty breathing, throat closing, and diffuse urticaria within minutes of ingesting a shellfish soup containing shrimp and crab. As an adult, she has had multiple instances of allergic hypersensitivity due to inhalation of shellfish when in the vicinity where someone consumes shellfish soup or when shellfish is prepared on a grill. Similarly, she has had throat closing after consuming a shrimp-based seasoning. Since childhood, she avoided crustaceans and mollusks but denies symptoms when consuming finfish (cod, tilapia, salmon, tuna), wheat, hen's eggs, cow's milk, soy, peanuts, tree nuts, seeds, fruits, vegetables, and spices. Her vital signs and physical exam were unremarkable. Food allergy skin test was positive to all shellfish tested.

To explore the phenomenon of "pancake shock", it helps to understand the basis of shellfish allergy and allergen cross-reactivity. Shellfish allergy (SA) is the most common food allergy among adults and is one of the eight major food allergens. The two main phenotypes of shellfish allergy are crustacean-allergic, which is most common, and mollusk-allergic. Crustaceans include shrimp, prawn, crawfish, lobster, and crab while Mollusks include bivalves (mussels, scallops, oyster, clams), gastropods (snail, abalone, cockle) and cephalopods (squid, octopus).[1] Crustacean-allergic adults more commonly report skin, mucosal and respiratory symptoms while mollusk-allergic adults more often report GI symptoms. It is possible for patients to be allergic to crustaceans and not mollusks, and vice versa, but it is challenging to quantify how frequently overlap occurs.[1]

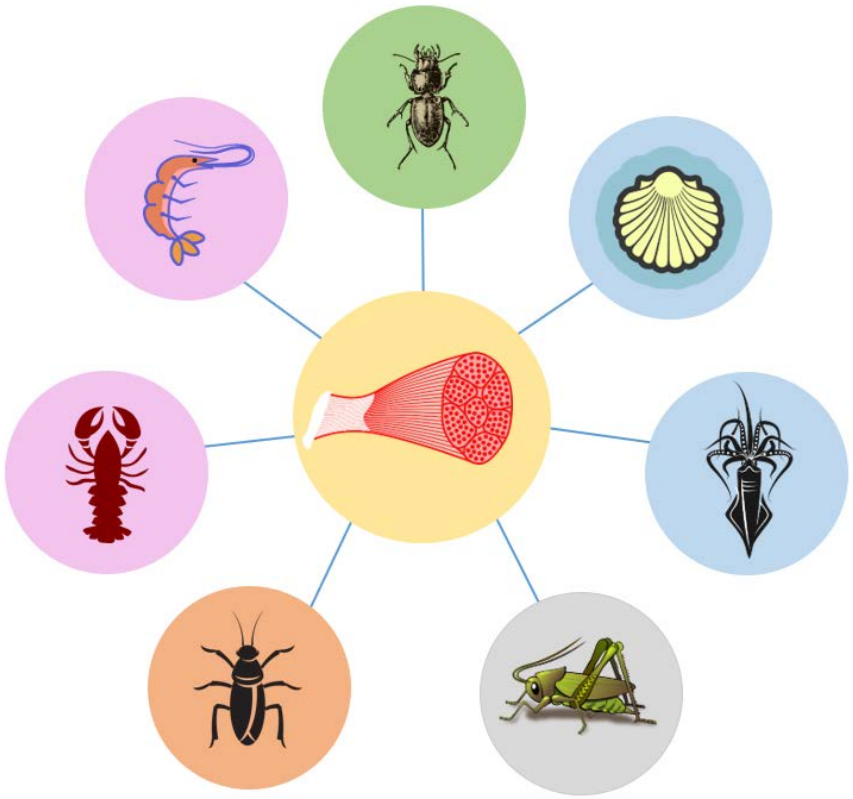
Factors that increase the odds of SA include shoreline residence, having insect sting or hymenoptera venom allergy (more often associated with increased odds of severe crustacean allergy), and allergic rhinitis (more often associated with increased odds of severe mollusk allergy). The mean age of SA onset is 17 years in children and 28 years in adults.[2] The main protein responsible for SA is tropomyosin, a protein involved in skeletal muscle contraction.[1] Tropomyosin in present in all shellfish species and can represent up to 20% of the total protein content in shellfish. Tropomyosin has been identified as an allergen found in crustaceans, mollusks and a fish parasite called *Anisakis simplex.* It has also been identified as an inhalant allergen in arthropods such as cockroaches and mites. As it pertains to cross-reactivity with shellfish allergens, dust mites are a well-known example. However, emerging evidence suggests that cross reactivity also exists in other insects such as weevils, or Curculionoidea, due to homology among tropomyosin across species. These proteins can maintain integrity despite heating and cooking and therefore maintain their risk of inducing allergic hypersensitivity reactions.[3]

Weevils are common pests that infest dry goods such as lentils, grains, starches, cake mix, cereals, pastas and flour. There are over ninety-five thousand different weevil species with the rice weevil *(sitophilus oryzae)*, maize weevil *(sitophilus zeamais)* and wheat weevil *(sitophilus granarius)* identified as the most common types found in pantries. In a study of allergic reactions to lentils versus lentils infested by the lentil-weevil pests, extracts of infested-lentils induced IgE mediated allergic reactions in patients who were otherwise asymptomatic to non-infested lentil extract.[4] The tropomyosin protein within weevils is the suspected culprit.

The concept of "pancake shock" hinges on both the cross-reactivity between shellfish and insects and the fact that flour is a common host for insects such as weevils. While weevils are often the size of a grain of rice, they can leave very little trace of their presence. Weevils can invade sacks of flour, lay microscopic eggs, and exit without leaving a trace visible to the naked eye. This occurs most commonly in warmer climates. Because the allergenic protein tropomyosin is heat-resistant, even cooked pancakes containing weevil infested-flour can trigger anaphylaxis in those who have a shellfish allergy such as our patient of interest. While it may be unappetizing to ingest

and/or consume food with weevils or their larvae, in general, weevils or weevil larvae are not harmful if ingested and do not cause ill effects in patients without shellfish allergy.

During the interview, our patient recalled that the pancake batter had weevils. She further stated that the batter was sifted before use because it appeared to have only mild contamination and typically grains containing weevils are only thrown out if rife with weevils. Unfortunately, there is no commercially available test to evaluate for IgE mediated hypersensitivity to weevils. Given the patient's known history of IgE mediated shellfish hypersensitivity, known ingestion of pancake batter containing weevils, positive skin test to shellfish and the shared allergenic protein tropomyosin found in both Shellfish and weevils, the patient was diagnosed with weevil allergy. The patient was counseled that to prevent recurrence of "pancake shock", she is advised to continue avoiding shellfish (mollusks and crustaceans), the parasitic nematode *Anisaki simplex* (known to infect fish, crustaceans and squid), helminths *Ascaris lumbricoide*s, and additionally, edible crickets, weevils, dust mites, chironomids (also known nonbiting midges or lake flies), silverfish, and cockroaches (Figure 1). Based on this case, it is important to advise patients with shellfish allergy to store flour in the freezer to prevent infestation with weevils, mitigating the risk of "pancake shock".



This figure illustrates that tropomyosin, within skeletal muscle, shares similar allergenic proteins across several species, including but not limited to those pictured (from top, clockwise): weevil, clam, squid (mollusk), cricket, cockroach, lobster, and shrimp (crustacean).

REFERENCES

1. **Wong L, Tham EH, Lee BW**. An update on shellfish allergy. *Curr Opin Allergy Clin Immunol*. 2019 Jun;19(3):236-242. doi: 10.1097/ACI.0000000000000532. PMID: 30893087.
2. **Warren CM, Aktas ON, Gupta RS, Davis CM**. Prevalence and characteristics of adult shellfish allergy in the United States. *J Allergy Clin Immunol*. 2019 Nov;144(5):1435-1438.e5. doi: 10.1016/j.jaci.2019.07.031. Epub 2019 Aug 8. PMID: 31401288; PMCID: PMC6842441.
3. **de Gier S, Verhoeckx K**. Insect (food) allergy and allergens. *Mol Immunol*. 2018 Aug;100:82-106. doi: 10.1016/j.molimm.2018.03.015. Epub 2018 May 3. PMID: 29731166.
4. **Armentia A, Lombardero M, Blanco C, Fernández S, Fernández A, Sánchez-Monge R**. Allergic hypersensitivity to the lentil pest Bruchus lentis. *Allergy*. 2006 Sep;61(9):1112-6. doi: 10.1111/j.1398-9995.2006.01123.x. PMID: 16918515.