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Literature review and perspective on mosquitoes induced allergies

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Abstract

Mosquitoes are considered a global health by transmitting lethal infectious diseases threat worldwide with potentially large fatalities rates such as malaria, dengue, and yellow fever, during their bites and feed on the blood of vertebrates including humans. Mosquitoes are globally existing and usually more active in hot and humid environments, where they can multiply and spread.

Another important health issue is mosquitoes' bites allergic immune reactions that can be potentially life-threatening and require allergist/ immunologist intervention and actions.

Keywords: Mosquito bites; Humid environments; Anaphylaxis; Skin prick test; RAST.

1. Introduction

Saudi Arabia consists of 13 provinces and is the major portion of the Arabian Peninsula, that is in the heart of the middle east. The weather of the country is hot and humid most of the time in both of its seacoasts, while most of the other areas are very hot in the summer and cold in the winter months, apart from high altitudes [1]. Climatic conditions, such as temperature and rainfall have significant effects on the distribution and abundance of mosquito species, however, other influences are host availability and human activities, and changes in land cover [2].

These factors have major implications on pathogen transmission by mosquitoes through their vectorial capacity, rate of survival and abundance of mosquito species. Many previous publications have focused on the identification of mosquitoes [3 – 9], but understanding the climatic conditions is essential for disease control. Mosquito-borne pathogens are known to cause several diseases worldwide, and Malaria in particular was considered an endemic disease in Saudi Arabia since early 1900 [10,11]. Female mosquitoes transferring thousands of pathogens (e.g; viral particles), that might be found in their saliva, during their bites and feed on the blood of vertebrates including humans [12,13]. Mosquitoes' species include Aedes aegypti, Aedes albopictus, Aedes scapularis, Anopheles baimaii, Anopheles maculipennis, Culex fusco cephala, Culex quinquefasciatus and Psorophora columbiae. These species are thought to pose a high risk to global health because of their ability to carry mosquito-borne viruses [14,15]. Mosquito-transmitted diseases in Saudi Arabia including Plasmodium species, dengue virus, Rift Valley fever virus and microfilariae [12–16]. This situation highlights the urgent need for actions to mitigate mosquito and mosquito-born-disease (MBD) pathogen distributions [17,18].

Another health issues that caused mosquitoes' bites are allergic immune reactions that range from large localized skin lesions, to systemic reactions including urticaria, angioedema, and life-threatening anaphylaxis can develop, where allergist/ immunologist roles are crucial.

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2. Discussion

Mosquitoes are globally exert a global health threat with potentially large fatalities rates worldwide by transmitting lethal infections such as malaria, dengue, and yellow fever. However, we are here addressing other issue, where mosquitoes can induce allergic immune response and its consequences in humans.

During mosquitoes' bites and feed on the blood of humans, mosquito saliva can trigger allergic immune reactions that range from large local skin reactions (the most common are itchy erythematous skin lesions), but in some occasions, systemic reactions including urticaria, angioedema, and anaphylaxis [19 – 26]. Anaphylaxis is a severe and rapid-onset allergic reaction that is marked by itchy skin rash, breathing difficulties or circulatory issues that can potentially be life-threatening. Cofactors that augment the severity of clinical symptoms and increase the risk of poor outcomes include exercise, stress, infectious diseases, underlying mast cell disease, active allergic disease such as asthma, advanced age, intake of certain medications, history of previous anaphylaxis, and delayed or missed administration of adrenaline. [27]

There are certain population who may be at higher risk for an allergic reaction to a mosquito bite including outside workers or frequently exercising outdoors, young children, people not previously exposed to the local mosquito bites, and immunocompromised patients, i.e; HIV or cancer [28]. Having said that, very severe reactions with systemic symptoms to mosquito bites could develop in patients with Epstein-Barr virus-associated T/natural-killer cell-associated lymphoproliferative disorders, underlying immune disorders [29]. However, naturally acquired desensitization to mosquito saliva is more common in children ('skeeter syndrome'), with local allergic reactions that usually improve spontaneously with age, during long-term exposure to mosquito bites or both [30 – 31]. The reactions to mosquito bites are immunologically mediated in nature, that include severe local and systemic reactions involve immunoglobulin E, immunoglobulin G, and T-lymphocyte-mediated hypersensitivities in response to allergens in mosquito saliva [32]. There have been efforts to improve the reagents, but these are not commercially available worldwide [33]. Sirichit Wongkamchai et. al, reported that, the protein profiles of saliva, salivary glands and whole-body extracts were comparatively analyzed from four common mosquito species of Thailand and/or South East Asia; including *Aedes aegypti*. Mosquito saliva was the most important allergens that caused specific IgE responses found in the allergic subjects. The identification of major allergens in mosquito saliva having MWs of 36, 32 and 22 kDa, which could potentially improve the development of specific recombinant allergens, the diagnosis and ultimately specific immunotherapy [34 – 35]. Aed a 3, *Aedes aegypti*, is a major mosquito salivary allergen. Its recombinant form has biological activity and is suitable for use in skin tests and serum IgE assays in mosquito-allergic individuals [36].

Large local reactions to insects are generally not treated with immunotherapy but, at least there is improvement in the size of local reactions with the use of venom immunotherapy [37]. Ariano R and R. C. Panzani reported disappearance of local reactions due to mosquito *Aedes* and symptoms of allergic rhinitis in all twenty patients treated for 18 months with specific immunotherapy extract of the whole body of the mosquito *Aedes* communis, used for strong local immediate and delayed reactions, which was correlated with a statistically improvement of symptom and drug consumption scores [38]. Opasawatchai A. et al. studied 64 mosquito-allergic and 22 non-allergic healthy control subjects and concluded that the majority of mosquito-allergic subjects who live in the tropics have IgE reactivity to these allergens, which is important for development of diagnostic tests, component-resolved diagnostics, and future immunotherapy for mosquito allergy in tropical countries [39].

The use of mosquito repellents (i.e., basil, fennel and synthetic DEET) remain the most important preventive measures to avoid mosquito bites. However, the recommendations of American Academic of Allergy, Asthma and Immunology include consulting an allergy/immunology specialist who can help to establish the diagnosis of anaphylaxis and its cause when a patient developed anaphylaxis, and to carry epinephrine autoinjector for emergency use. However, for localized symptoms due to mosquito bites, other measures to relieve symptoms which include elevation of the affected area and apply ice to reduce swelling and pain, to apply over-the-counter lotion to the affected area, to clean blisters with soap and water without breaking them, and if itching persists, then to try topical steroids or oral antihistamines. But to consult a physician if the swelling progresses, systemic symptoms develop, or the area appears infected [40].

3. Conclusion

Mosquitoes are a global health threat responsible for transmitting lethal infections with high fatalities rates worldwide. However, another threat is allergic immune reactions to mosquito bites with potential life-threatening anaphylaxis, that are still underdiagnosed and undertreated.

These situations highlight the urgent need for actions to mitigate mosquito and mosquito-born-disease pathogen distributions.

Anaphylaxis action plan should be undertaken in all anaphylaxis cases and preventive measures should be taken seriously and carried out simultaneously. Recombinant mosquito saliva allergens with biological activity were developed, that will significantly improve diagnosis of mosquito allergic immune response, its management and eventually will improve specific immunotherapy for patients with systemic reactions.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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