Anaphylaxis Caused by a Mouse Bite in a Laboratory Researcher

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Laboratory animal allergy is a major occupational health problem for personnel working in close contact with animals. Rodents, particularly rats and mice, are the animals that most frequently cause allergic disease owing to their widespread use in experimental research [1,2]. Anaphylaxis due to animal bites is rarely reported. However, given that some authors have identified unpublished cases, its incidence may be underestimated [3]. The risk factors for rodent allergy include the level of exposure to rodent-derived aeroallergens, history of atopy, and working with male rodents [4,5].

We report the case of a 42-year-old female laboratory worker who was bitten on the palmar aspect of the distal phalanx of the left index finger while extracting a urine sample from a healthy male mouse via bladder catheterization. She had received several mouse bites in the past without incident; however, this time the bite wound bled. Approximately 5 minutes later, she developed generalized cutaneous pruritus, facial erythema, dyspnea, urticaria, tachypnea, and general malaise. Her vital signs were within the normal range. The symptoms improved with inhaled salbutamol, oral corticosteroids, and antihistamines in the hospital emergency department.

On the day of the bite, she had performed intense physical exercise half an hour before the reaction. Since then, she has not returned to work. She reported previous occupational exposure to pigs and denies exposure to laboratory rats or other animals at work other than mice. She did not report urticaria, anaphylaxis, or respiratory symptoms when working with mice, nor did she have a history of asthma, rhinitis, urticaria, or atopic dermatitis. She reported no food or drug allergy.

Skin prick tests with commercial epithelium extracts were positive to mouse (3×3 mm), hamster (3×3 mm), and rabbit (4×4 mm). The results of skin prick tests with other common inhalants (pollens, dust mites, and molds) were negative.

Total serum IgE (ImmunoCAP, Thermo Fisher) was 63.4 kU/L, basal tryptase was 2.21 µg/L, and the results of specific IgE were as follows: mouse epithelium, 0.23 kU/L; mouse urine protein, 0.16 kU/L; and rat epithelium, rat serum protein, and pig epithelium, <0.10 kU/L. Determination of the amount of protein by the Bradford method revealed values of 0.16 mg/mL, 0.88 mg/mL, and 1.56 mg/mL for protein in urine, epithelium, and mouse saliva, respectively.

SDS-PAGE and IgE-western blot were carried out under nonreducing and reducing conditions (with mercaptoethanol)

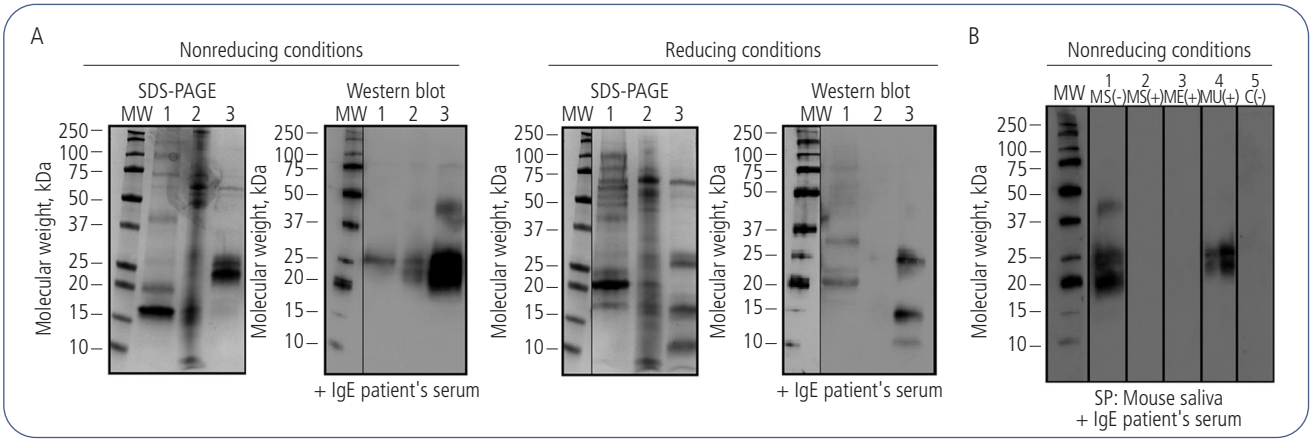

Figure. A, SDS PAGE/IgE-Western blot under reducing conditions (loading buffer with 5% β-mercaptoethanol) and nonreducing conditions. Lane 1, mouse urine; Lane 2, mouse epithelium; Lane 3, mouse saliva. B, IgE-Western blot inhibition. Solid phase: mouse saliva. Lane 1, uninhibited serum (positive control); Lane 2, serum inhibited with mouse saliva; Lane 3, serum inhibited with mouse epithelium; Lane 4, serum inhibited with mouse urine; Lane 5, blocking solution without serum (negative control). SD indicates solid phase.

on urine, saliva, and mouse epithelium samples. Analysis under nonreducing conditions revealed proteins of around 25 kDa in urine, 19 kDa and 25 kDa in epithelium, and a high-intensity IgE-binding band of 19-25 kDa and a low-intensity band of 37-45 kDa in the mouse saliva sample. Analysis under reducing conditions revealed proteins of around 20 and 31 kDa in urine and around 10, 14, and 24 kDa in saliva (Figure).

Western blot inhibition was performed with patient sera and mouse saliva in the solid phase to determine whether mouse saliva proteins were the allergenic source responsible for the patient's symptoms. The inhibitors were saliva, epithelium, and mouse urine. The results showed total IgE-binding inhibition in the saliva and mouse epithelium samples using the patient's serum, with no inhibition in the mouse urine sample.

The chronological relationship in this case points to anaphylaxis resulting from a laboratory animal bite as the most likely scenario. Approximately 15% of exposed researchers become sensitized to laboratory animals during the first 3 years of work, and approximately 10% may also experience allergic symptoms such as rhinoconjunctivitis, skin reactions, asthma, and anaphylaxis [4,5]. Cofactors contribute to approximately 30% of adult anaphylactic reactions [6]. However, the patient we report did not have allergic symptoms prior to the reaction, and although atopy and respiratory allergy to laboratory animals may be risk factors, anaphylaxis after an animal bite could also be the first sign of allergy [7].

Mouse and rat allergens are the most common causes of allergy in laboratory workers. However, sensitization to multiple animals can develop in individuals exposed to a single species [1,2]. Multiple sensitizations may reflect IgE cross-reactivity between the major rodent allergens, since, for example, Mus m 1 and Rat n 1 have 66% homology [8]. In the present case, the patient was sensitized to mouse, hamster, and rabbit epithelium, although she had only been exposed to mice, indicating that the allergen involved very likely cross-reacted with allergens from other animals.

Most respiratory allergens of animal origin, such as Mus m 1 (19 kDa), Rat n 1 (18.7 kDa), Cav p 1 (20 kDa), and Ag 1 (17 kDa), which are the major allergens of mouse, rat, guinea pig, and rabbit, respectively, are lipocalins found mainly in urine and epithelia [9,10]. These proteins are produced in the liver or secretory glands. They are present in body fluids and secretions such as saliva and urine and act as transporters of retinol, odorants, steroids, lipids, and pheromones [8]. Nevertheless, other animal allergens have also been reported, including Mus m 2 (16 kDa), Cap p 2, Ag 2, and albumins [9].

Proteins of 19 kDa and 25 kDa from mouse epithelium and of 19-25 kDa and 37-45 kDa from mouse saliva might be responsible for the patient's hypersensitivity reaction to the mouse bite. The Western blot inhibition assay pointed to the involvement of mouse saliva proteins that cross-reacted with mouse epithelium owing to the total IgE-inhibition obtained with both saliva and mouse epithelium. The molecular mass of proteins of 19 kDa could correspond to lipocalins, whereas the high-molecular-weight proteins implicated in the reaction we identified have not yet been described in the literature.

We present a case of allergy to mouse saliva and epithelium with anaphylaxis as a manifestation of the bite and with physical exercise as a possible cofactor. Diagnosis should be followed by consultation with the occupational risk unit to determine which measures should be implemented to reduce exposure in the patient's workplace. In addition, the patient must be instructed in the use of self-injectable adrenaline to ensure prompt and timely treatment if necessary. More research will be needed to identify new elements involved in mouse epithelium allergy.

The patient gave her consent for the publication of this case report.

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Conflicts of Interest

The authors declare that they have no conflicts of interest.

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