

Laboratory Animal Allergy

An Occupational Hazard

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Laboratory animal allergy is a relatively common work-related condition that can result in serious consequences for affected workers' health. Research institutions are also negatively impacted by laboratory animal allergy through lost productivity, increased workload for others, and increased health care costs (Wolfe & Bush, 2001; Wood, 2001). Since 1989, the National Institute for Occupational Safety and Health (NIOSH) has recognized laboratory animal allergy as an occupational hazard (Bush, 2001). It is estimated that one-third of laboratory animal workers will develop laboratory animal allergy symptoms, and more than 10% of those workers will develop occupational asthma, persisting even after exposure to the offending allergen ends (Gordon & Preece, 2003). This article describes the general physiological mechanisms responsible for laboratory animal allergy and risk factors for developing the condition. Common routes of exposure are described with indications for how occupational health nurses can prevent and manage this condition in the workplace.

EPIDEMIOLOGY

The number of individuals exposed to laboratory animals at U.S. worksites is estimated at 90,000, although some sources suggest a range from 40,000 to 125,000. The incidence of laboratory animal allergy is difficult to determine because those workers with a confirmed diagnosis of laboratory animal allergy are added to those with symptoms of laboratory animal allergy but no confirmed diagnosis. The overall incidence, however, is estimated at 15% and the incidence of asthma due to laboratory animal

allergy is approximately 2%. The prevalence of laboratory animal allergy-induced asthma is estimated to range from 11% to 44% (Elliott, Heederik, Marshall, & Peden, 2005). According to Gordon and Preece (2003), the incidence among exposed workers in the first few years of animal work varies from 5% to 40%. Because definitions of laboratory animal allergy differ, reported symptoms versus laboratory evidence of allergy, there is wide variability in incidence and prevalence (Bush & Stave, 2003). If a questionnaire is used to determine laboratory animal allergy, and definitive diagnosis is not made with laboratory testing, incidence and prevalence rates are much higher. Prevalence rates are also impacted when affected workers stop working with laboratory animals because of severe symptoms or worsening illness.

MECHANISM OF LABORATORY ANIMAL ALLERGY

Exposure begins with the inhalation of allergens into the lungs. The substances inhaled are most often animal dander and urinary proteins. If the employee experiences an allergic reaction, the reaction begins with the stimulation of immunoglobulin (IgE) antibodies. This initial response is sensitization. Antigen-presenting cells in the lungs and the skin capture the antigen (allergen) and stimulate T-cell replication and the production of cytokines leading to a histamine and leukotriene response. This response causes airway smooth muscle constriction, tissue edema, increased mucous secretions, and nerve stimulation. The employee feels a tightness in the throat, has difficulty breathing, coughs and wheezes, has face, neck, and extremity swelling, and develops hives, runny nose, sneezing, and itching (Wolfe & Bush, 2001).

Once allergen-specific IgE antibodies are present, subsequent exposure to the allergen stimulates a response in as little as 10 to 15 minutes (Wolfe & Bush, 2001). For approximately half of those affected, a late-phase reaction

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follows the initial response in 3 to 4 hours. This reaction peaks in 4 to 8 hours and resolves after 12 to 14 hours.

The cells most often involved in the inflammatory response to an allergic reaction are eosinophils, macrophages, lymphocytes, and neutrophils, although the presence of eosinophils in the tissues is the hallmark of allergic inflammation (Bush, 2001). Circulating antigen-specific IgE binds to mast cells and basophils. Interaction of the allergen with specific IgE antibodies triggers the release of histamine, leukotrienes, and prostaglandins, and results in the classic symptoms of an allergic reaction. With time, a more chronic disease, such as asthma, can develop (Bush, 2001).

RISK FACTORS

Sensitization often occurs within the first 3 years of employment in an animal facility. Risk factors include a personal or family history of atopy, preexisting allergies to other allergens not found in the workplace, a significant exposure to laboratory animals, and possibly smoking cigarettes (Bush, 2001). Atopic workers are as many as 11 times more likely to become sensitized (Gordon & Preece, 2003). A detailed history is vital when attempting to diagnose laboratory animal allergy and should include both current and past employment history, current symptoms, and potential risk factors (Bush, 2001).

SYMPTOMS OF LABORATORY ANIMAL ALLERGY

The symptoms of laboratory animal allergy can range from mild to severe and often depend on the time and degree of allergen exposure. The most common symptoms are rhinitis and conjunctivitis. Skin reactions can occur and may appear as hives or maculopapular rashes. They are usually caused by contact with tails, claws, urine, or dander. Asthma is diagnosed in 20% to 30% of symptomatic workers. Asthmatic workers wheeze and complain of shortness of breath. Anaphylaxis, a severe and sometimes fatal allergic reaction, can occur, although it is uncommon. Anaphylaxis manifests with itching, hives, swelling of the lips and extremities, respiratory distress, hypotension, and an asthma attack (Bush, 2001). Animal bites, more than other forms of exposure, pose the greatest danger of resulting anaphylaxis (Harrison, 2001).

MORE ABOUT ALLERGENS

Rats and mice are the source of most allergens, primarily because these animals are most often used in research and are present in large numbers. Rat fur, dander, and saliva contain allergens, but because rodents have persistent proteinuria, their urine is also a major source of allergens. In cats and dogs, hair, dander, and saliva are the major sources of allergens (Bush, Wood, & Eggleston, 1998). Allergy symptoms have also been reported after exposure to rabbits, guinea pigs, hamsters, and monkeys (Wood, 2001). According to Elliott et al. (2005), species-specific data suggest that the rates of allergy symptoms are higher in response to rabbit exposures because rabbits shed more fur and spray their urine.

Animal allergens are carried on small particles, so

they can remain airborne and are easily respirable (Bush et al., 1998). As with other respirable substances, the smaller and denser the particle, the deeper it can travel the respiratory system. Cleaning bedding and cages and feeding the animals are activities that can result in significant allergen exposure because these activities cause the allergen to be airborne. Therefore, animal handlers and caretakers develop allergy symptoms more frequently than others who do not have direct contact with the animals.

ROUTES OF EXPOSURE

Inhalation is the most common route of exposure to animal allergens. Skin and eye exposures are also likely among animal handlers. An exposure can also be percutaneous if a worker is stuck with an allergen-contaminated needle or sustains an animal bite (Harrison, 2001).

SURVEILLANCE

The purpose of health surveillance is to monitor and prevent disease, identify the signs of disease in its early phases, and institute interventions. Monitoring also evaluates the health of an entire group so the occupational health nurse can analyze trends in disease incidence and use the data to determine the effectiveness of health and safety programs. The Occupational Safety and Health Administration (OSHA) does not have a standard requiring employers to monitor employees in animal laboratories. The Occupational Safety and Health Act of 1970 or General Duty Clause states that the Act is "to assure safe and healthful working conditions for working men and women; by authorizing enforcement of the standards developed under the Act; by assisting and encouraging the States in their efforts to assure safe and healthful working conditions; by providing for research, information, education, and training in the field of occupational safety and health; and for other purposes" (OSHA, 2002). According to Seward (2001), research institutions that receive funding from the National Institutes of Health must comply with the requirements of the National Research Council. A National Research Council (1996) publication regarding caring for and using laboratory animals states an occupational health and safety program must be a component of an overall animal care and use program. The program must be in agreement with federal, state, and local regulations and should maintain a safe and healthy workplace. Components of the program depend on the specific facility, research activities, hazards, and animal species.

A laboratory animal allergy surveillance program may include preplacement or baseline questionnaires and health evaluations and screenings, followed by periodic questionnaires and health evaluations if laboratory animal allergy symptoms become apparent. In many institutions, the periodic questionnaire is reviewed annually. For those workers who exhibit symptoms and are still working with animals, subsequent evaluations will likely be more frequent.

Institutions that elect to do preplacement testing as a possible predictor of laboratory animal allergy may use skin prick testing, although the possibility of poor-quality reagents may affect the results. Additionally, a measurement of IgE in the blood, or a radioallergen sorbent test,

could be used. Other possible tests are pulmonary function tests and peak flow readings, at baseline and if disease occurs. If an employee develops laboratory animal allergy symptoms, peak flow readings should be recorded sequentially over time (i.e., four times per day). This procedure can yield useful information about the possible etiology of asthma. Pulmonary function tests, specifically forced vital capacity and forced expiratory volume in the first second, can also assist in diagnosing asthma if measured prior to and after work. Treatment may include antihistamines, bronchodilators, and steroids for symptoms. Administrative controls may include personal protective equipment, modified job duties, or exposure avoidance. Some workers with symptoms of laboratory animal allergy are evaluated in the company health service and often referred to an allergist for testing, treatment, and further recommendations (Seward, 2001).

INTERVENTION AND PREVENTION

The goal of prevention and intervention is to reduce the number, intensity, and duration of worker exposures to airborne allergens. As with other occupational health and safety programs, the hierarchy of prevention strategies is engineering, administrative, and work practice controls and personal protective equipment. Controls, regardless of kind, must be accepted by the workers, compatible with the workplace, and cost-effective (Harrison, 2001).

Because protein allergens can be found not only on the animal but also on animal waste, cages, bedding, and tissue samples, ventilation is essential (Fisher, Saunders, Murray, & Stave, 1998). One of the NIOSH recommendations is to increase the ventilation rate and humidity in animal housing areas to decrease airborne allergen levels. Additionally, the animal housing and handling areas should be ventilated separately from the rest of the facility, and airflow should be directed away from workers and toward the back of cages. Ideally, cages are installed with ventilated cage racks or a filter top design (NIOSH, 1998). To contain allergens, animal-holding rooms should be at negative pressure in relation to hallways (Gordon & Preece, 2003). Methods to achieve administrative and work practice controls appear in the Sidebar.

Personal protective equipment used to reduce allergen exposure can include eye protection, a long-sleeve gown or a long laboratory coat, shoe and head coverings, gloves, and respiratory protection. The protective equipment has to be used properly to be effective, so training in the use of all protective equipment—no matter how simple—is required. If respirators are used, an OSHA-compliant respirator program must be implemented. The respirator program implemented in coordination with the safety and industrial hygiene departments should consist of a health questionnaire, fit-testing, and training in the selection, care, and use of respirators. Because there is no OSHA standard for laboratory animal work, there is no specific requirement as to the level or kind of respiratory protection. The type of work performed, the number and intensity of exposures, and worker sensitivity determine the type of respiratory protection needed. In general, workers who have laboratory animal allergy symptoms

Methods to Achieve Administrative and Work Practice Controls

Perform animal work within ventilated hoods or safety cabinets.

Decrease the number of animals in the room.

Consider using an alternate species when possible or female rats, as they are less allergenic.

Consider altering work schedules and instituting job rotation.

Use absorbent pads for bedding.

Reduce skin contact with animals by wearing protective clothing and gloves. Ensure gloves are either tucked into or fully over the top of the sleeves of outer protective garments for full skin coverage.

Provide work uniforms that employees leave at work at the end of shifts to avoid tracking allergens to other areas of the facility or their homes.

Discard personal protective equipment after use and before leaving the area.

Wash hands frequently and increase the frequency of "wet" wash downs of animal areas.

To further reduce allergen exposure, minimize paperwork during animal handling as paper may be contaminated and then taken out of the room. Paperwork that must be removed from the animal area should not be left on a desk in an uncontaminated area where unprotected workers can be exposed.

Training should be ongoing and include information about work practices, hazards, risks, hygiene, laboratory animal allergy symptoms, and the importance of reporting symptoms as soon as they are recognized.

should be fitted for disposable, negative pressure, half-face filtering respirators (i.e., an N95, a powered air-purifying respirator, or a full-face air-purifying respirator with a high-efficiency particulate air filter). The latter two choices can be either impractical or uncomfortable but they are the most effective (Harrison, 2001). Many animal workers prefer to wear a dust mask because it is not tightly fitted and is more comfortable. Because dust masks do not create a seal between the mask and the face, airborne allergens can easily pass into the respiratory tract. If workers have severe laboratory animal allergy symptoms, they will likely have to be excluded from the work area (Seward, 2001). Laboratory animal workers may be restricted from working with offending animals if symptoms do not resolve with the proper personal protective equipment and treatment. Less frequently, workers may have to be excluded from laboratory animal work al-

IN SUMMARY

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- 1 Laboratory animal allergy is a relatively common work-related condition occurring in an estimated one-third of laboratory animal workers. More than 10% of these workers develop occupational asthma.
- 2 Sensitization often occurs in the first 3 years of employment. Risk factors include a personal or family history of atopy, other preexisting non-work-related allergies, and a significant exposure to laboratory animals. Inhalation is the most common route of exposure, followed by skin and eye exposures.
- 3 Preplacement testing and regular health surveillance screening may be used by institutions employing laboratory animal workers to identify, monitor, and prevent allergies and disease in these workers.
- 4 Intervention and prevention techniques (i.e., engineering, administrative, and work practice controls and personal protective equipment) are key to controlling and preventing allergy symptoms and occupational asthma.
- 5 Occupational health professionals play an important role in the early identification of at-risk and affected employees, and can render the necessary treatment, referrals, education, and recommendations to prevent debilitating illness.

together if they exhibit severe symptoms, have developed occupational asthma, or have had anaphylaxis.

IMPLICATIONS FOR OCCUPATIONAL HEALTH NURSES

Occupational health nurses and occupational physicians have important roles in the identification of those employees who may be at risk for developing laboratory animal allergy, and those who demonstrate early symptoms of laboratory animal allergy. By taking a proactive role, perhaps by providing at least annual health surveillance, the practitioner can discuss work practices, type and extent of personal protective equipment worn by the employee, and any new allergy symptoms or changes in existing allergy symptoms. If needed, early health in-

tervention can begin and modifications in personal protective equipment or work practices can be discussed. Health surveillance programs and identification of affected employees can lead to appropriate treatment by experienced occupational health staff. These employees are often referred to an allergist for additional treatment and work recommendations. Although training and education should be offered routinely in these work areas, physicians and nurses can also provide counseling and continuing education to facilitate early recognition of laboratory animal allergy symptoms, compliance with disease management protocols, and appropriate changes in work practices.

CONCLUSION

Laboratory animal allergy is a common occupational disease that can lead to occupational asthma. Identification of those employees who are at risk for and early identification of those with laboratory animal allergy symptoms can prevent disease from occurring or effectively manage early stages of disease. The desired goal is to support the health and productivity of the work force and prevent lost work time.

Occupational health practitioners, safety professionals, industrial hygienists, and management must work together to ensure that engineering, administrative, and work practice controls are in place and training and education about risk factors, laboratory animal exposures, and proper work practices are ongoing. Well-informed employees are likely to minimize their exposures, improve their work practices, and use controls (e.g., personal protective equipment) properly.

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