Occupational Health and Safety in the Laboratories of Experimental Animals

Deney Hayvanları Laboratuvarlarında İş Sağlığı ve Güvenliği

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ABSTRACT

In our country, laboratories are working areas where there are many risks in terms of occupational health and safety. The knowledge levels, attitudes, and behaviors of employees in terms of OHS should be well known, especially in these work areas where biological, chemical, and physical risk factors are intense. Considering the researchers as well as employees in experimental animal laboratories, the OHS knowledge level of those employees in these centers is important not only for protecting themselves but also for the protection of incoming researchers and their families. With this review, it has been tried to give up-to-date information about the hazards that employees and researchers may encounter and the precautions to be taken according to the biosafety levels in laboratories where animal experiments are carried out.

Keywords: Experimental animals, occupational health and safety, laboratory.

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ÖZET

Ülkemizde laboratuvarlar, iş sağlığı ve güvenliği bakımından pek çok riskin var olduğu çalışma alanlarıdır. Özellikle biyolojik, kimyasal ve fiziksel risk faktörlerinin yoğun olduğu bu çalışma alanlarında faaliyet gösteren çalışanların İSG bakımından bilgi seviyeleri, tutum ve davranışları iyi bilinmelidir. Deney hayvanları laboratuvarlarında çalışanların yanı sıra dışarıdan gelen araştırmacılar da düşünüldüğünde, bu merkezlerde çalışanların İSG bilgi düzeyleri yalnızca kendilerini korumak için değil, gelen araştırmacıların ve ailelerinin korunması açısından da önem arz etmektedir. Bu derleme ile hayvan deneylerinin yapıldığı laboratuvarlarda biyogüvenlik seviyelerine göre çalışanların ve araştırmacıların karşılaşabilecekleri tehlikeler ve alınması gereken önlemler hakkında güncel bilgiler verilmeye çalışılmıştır.

Anahtar Sözcükler: Deney hayvanları, iş sağlığı ve güvenliği, laboratuvar.

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INTRODUCTION

Occupational health and safety (OHS) include activities aimed at protecting the individual from risks and unsafe situations and behaviors in the working environment (1). Protecting the health of workers can be achieved through health checks and surveillance of the working environment. Under the supervision of the working environment, the presence of many physical, chemical and biological factors affecting health in the workplace and their levels in the environment should be investigated and necessary precautions should be taken (2,3).

Experimental research centers that carry great risks are important centers that ensure that experimental research using laboratory animals is carried out within the framework of ethical rules. In these centers, experimental animals are produced and maintained for research projects under the control of veterinarians, and basic laboratory requirements and technical conditions are provided for the experimental research. In the Hazard Classes List Decleration of the Ministry of Labor and Social Security, according to the list of hazard classes in terms of occupational health and safety, the danger group is not specified for those working in the laboratory of experimental animals. However, research laboratories works are included in the very dangerous work section of this list (4,5,6).

There is always a risk of encountering various infectious agents and accidents for those (veterinarians, animal caretakers, cleaning personnel, technical personnel, etc.) working in the laboratories of experimental animals (5,7). In particular, diseases that can be transmitted from animals to humans (Rat-bite, Salmonella, Leptospirosis, Hantaviral disease, etc.) and various allergens (animal hair, bedding, urine, and saliva, etc.), traumas originating from animals and all biological materials (biting, scratching, urination and defecation, etc.), unsuitable working environment (wet floor, inappropriate storage, dirty environment, etc.), chemical agents used (carcinogens, mutagens, toxic inhalants, acid-alkali agents, pesticides), chemical allergens, etc.), surgery and medical instruments (scalpel, scissors, injector, peripheral venous catheter, etc.) and laboratory equipment (x-ray device, inhalation anesthesia device, centrifuge device, etc.) are among the risks that may ocur (8,9,10). According to a recent study, the most common injuries in laboratories are listed as needle sticking, animal scratching/biting, mucous membrane cuts, personnel falls, and burns (11).

It is aimed to reduce or prevent occupational diseases and injuries by organizing OHS programs in research laboratories (6,12). The laboratory supervisor, the veterinarians (breeding and research managers), the personnel responsible for the care and feeding of animals, researchers, students, interns, secretaries, and personnel responsible for technical affairs (electricity, ventilation, etc.) should have knowledge of occupational health and safety practices. The hazards encountered by those working in the laboratory of experimental animals vary according to previous experiences, the subject of the research, and the species of animal to be used in the research. For example, although animal bites or scratches are common, they are not life-threatening. While animal allergies are also frequently seen, they can result in life-threatening diseases ranging from moderate rhinitis to chronic asthma. Diseases such as dermatitis, which are less frequently observed in workers, may cause the epithelial barrier to thin and transmit various infectious agents through the skin, leading to the formation of more important diseases. In addition, an experimental study using pathogens or toxic agents is more dangerous than an animal behavior study (13).

1. General precautions to be taken in terms of occupational health and safety in the experimental animals laboratory

In order to protect the study material, the environment, and the researcher in research carried out in the laboratory of experimental animals, first of all, general laboratory rules must be followed during the study. Inspecting the routine process by the laboratory supervisor and sharing the necessary rules for emergencies with the employees in writing and verbally, limiting the entrances and exits to the laboratory except for the personnel assigned to the laboratory, regular health checkings of the personnel in the unit before and after being recruited, wearing appropriate clothes while working in the laboratory (shoes or slippers should be closed, not wearing clothing that restricts movement or can be damaged such as a coat) and using gloves, apron, glasses and/or face protection made of personal protective materials, prohibition of eating and drinking food and smoking in the laboratory, not storing personnel's food in the laboratory, especially not applying scented cosmetics, avoiding jewelry and accessories that restrict work are some of the general laboratory rules. (10,14,15,16). It is aimed to protect occupational health with the information and applications made about these rules.

2. Special precautions of the laboratories of experimental animals

In order to ensure standardization in experimental animal laboratories, animal biosafety levels (ABSL) are divided into four categories by the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC) (15,17).

According to these categories;

- Laboratories with the least potential hazard for laboratory employees and the environment “ABSL-1”,
- Laboratories in which pathogens that cause disease in humans through percutaneous and mucous membrane contacts or the digestive tract are studied “ABSL-2”,
- Laboratories, where studies that cause serious or fatal diseases by an aerosol route on indigenous or exotic animals are carried out “ABSL-3”,
- Laboratories that are worked with very hazardous and exotic agents that are transmitted by aerosol or unknown routes are in the "ABSL-4" biosafety level.

2.1. Animal Biosafety Level-1 (ABSL-1)

These laboratories should be in an isolated part of the building, and the outer doors should be self-closing and self-locking. Staff should be received decent education about animals and experimental studies and be informed about potential hazards and risks. Veterinarian/s are responsible for taking care of animals, training staff appropriate for their job, identifying potential hazards, and taking necessary precautions (physical hazards, splashes, aerosolization, etc.) to prevent exposure to infectious agents.

A suitable medical supervisory program (vaccination, corrective and preventative actions, etc.) should be determined for the staff by carrying out a risk assessment. In particular, health screenings of staff should be done annually before and after hiring, and necessary information about possible dangers should be made taking into account individual sensitivities. The entrance should be limited and only responsible staff should be allowed in the rooms where the animals are located.

Visitors from outside the center, such as researchers, students, or technical staff, should also be informed of potential hazards. During the work, personal protective equipment (gloves, glasses, disposable aprons, etc.), mechanical pipetting devices, and special boxes for sharp objects (bistoury, injectors, etc.) should be used if necessary. At the end of each study, the working areas should be cleaned with disinfectants to prevent possible contamination, and an effective pest management program should be implemented.

In the laboratory, swatter for flies should be attached to the outward-opening window and must be checked by the staff regularly. Cages and pads should be cleaned with detergents, without autoclave. The floors must be made of non-slip material; cabinets and countertops must be resistant to heat, organic solvents, acids, alkalines, or other chemical agents. Ventilation in the animal rooms should be designed to be inland and recirculative; extra heat and humidity should be considered during cage washing. Adequate lighting should be used to prevent reflection and glare. The risk assessment must be conducted and eyewash sinks should be kept for emergencies if necessary (17,18,19).

2.2. Animal Biosafety Level-2 (ABSL-2)

In addition to ABSL-1, some further precautions should be taken for laboratories at this level studying factors that may cause pathological disease in humans. The laboratory should be in an isolated area from the sections where the staff will be crowded in numbers and, there should be a sign at the entrance indicating the level of biosafety. The outer doors should be self-closing and self-locking. According to the type of animal used or pathological agents in the laboratory, the "Laboratory Safety Manual" and the "Emergency and Disaster Response Plan" should be prepared by the manager and/or the chief veterinarian against potential physical hazards that may occur and those should be kept within easy reach of the staff (19). Due to the different degrees of sensitivity to infections and the immune system, staff should be trained about the possible dangers that may arise during the handling of infected animals and the use of infectious agents, at the same time medical supervision and vaccination programs should be carried out.

Physical equipment should be used in cases where infectious materials or aerosols may splash during the procedures. Entrances to animal rooms and sections with infectious materials should be restricted except for the personnel assigned and the doors should be opened inward and self-closing. All persons, including institutional staff, service personnel, and researchers, should be informed about potential hazards and precautions (physical hazards or pathogens, allergens, etc. used during research).

Sharp objects used in cases where parenteral injection, phlebotomy, fluid aspiration, or surgical operations should be carefully placed in puncture-proof containers or break disposable injectors should never bend and be broken.

Non-disposable sharp-edged materials should be placed in hard-walled containers for decontamination (autoclave, sterilizer, etc.). Dishwashing glass materials with infectious agents should be collected with the help of brushes and dustpans, tongs, or forceps without being handled when broken (15,17,18).

Medical supervision and vaccination programs should be carried out for laboratory staff and technical personnel by carrying out risk assessments against infectious agents used. If necessary, base serum samples should be stored (13). Biosafety cabinets (Class I and II) should be used during highly hazardous aerosol-producing operations, and personal protective equipment should be used in the absence of biosafety cabinets (20). After working with infectious agents, these areas should be cleaned and disinfected by trained personnel. Disinfection of cages can be carried out manually or by automatic washing machines. Situations that may result in exposure to infectious materials should be immediately evaluated and treated according to the safety manual. All transactions must be recorded.

Potential infectious materials or animal waste should be placed in durable, sealed, closed transport containers by providing decontamination (autoclave, chemical disinfection, etc.) before being directed to the medical waste unit. The outer surface of these containers should be disinfected again and a biohazard label should be affixed to the carrying container (17,18).

2.3. Animal Biosafety Level-3 (ABSL-3)

In laboratories of this level, some further precautions need to be taken in addition to ABSL-2, since research is carried out in which local or exotic agents cause serious or deadly diseases by aerosol. According to the species of animal used or pathological agents in the laboratory, the "Laboratory Safety Manual" and the "Emergency and Disaster Response Plan" should be prepared by the manager and/or the chief veterinarian against potential physical hazards that may occur and those should be kept within easy reach of the staff (17,19).

The laboratory should be in an isolated area from the sections where the staff will be crowded in numbers and, there should be a sign at the entrance indicating the level of biosafety. The outer doors should be self-closing and self-locking. There should be a double-door system between the laboratory area and other areas. Biosafety level mark must be on the door of rooms with infectious agents and animals. Entrances should be limited except for a few responsible staff. The doors must be gas-tight with continuous negative pressure, and the ventilation system should be high-efficiency particulate absolute HEPA-filtered to protect the environment and the employees. Cages and pad materials should be used after decontamination.

Protective clothing should be worn to prevent contamination during the study with animals and single or double gloves, glasses, face and respiratory protection apparatus should be worn after risk assessment. Gloves should not be worn outside animal rooms and should never be washed and reused. If protective clothing can be reused, it should never be taken home. It can only be worn again after being disinfected. Disposable clothing should be made of non-woven material, unbuttoned and rear-linking. After work, gloves should be removed and thrown into the medical waste bin and hands should be washed with disinfectants (18,19).

Medical supervision and vaccination programs should be carried out for laboratory staff and technical personnel by carrying out risk assessments against infectious agents used. If necessary, base serum samples should be stored (13). The use of cages with HEPA-filter insulators is recommended because it reduces the risk of infection from infected animals or animal pads. It is necessary to work in biosafety cabinets (class II) especially if the infected animal tissues and fluids are studied (20).

Potential infectious materials or animal waste should be placed in durable, sealed, closed transport containers by providing decontamination (autoclave, chemical disinfection, etc.) before being directed to the medical waste unit. The outer surface of these containers should be disinfected again and a biohazard label should be affixed to the carrying container (17,21).

2.4. Animal Biosafety Level-4 (ABSL-4)

Laboratories of this level are required to apply additional safety to ABSL-3 level measures due to the work with very dangerous and exotic agents, known to pass through aerosol or with no vaccines or treatments. The laboratory should be built or located in a separate building and isolation. There should be a biosafety level mark on the door, the entrances and exits should be recorded and checked by the manager and/or the chief veterinarian.

According to the type of animal used or pathological agents in the laboratory, the "Laboratory Safety Manual" and the "Emergency and Disaster Response Plan" should be prepared by the manager and/or the chief veterinarian against potential physical hazards that may occur and those should be kept within easy reach of the staff (17,19).

Especially to prevent microorganisms from spreading to the environment and staff, special personal protective equipment (aprons, bonnets, masks, glasses, etc.) should be worn and studied with automatic pipettes biosafety cabinets (class III). At the end of the study, protective clothes must be taken off and be taken a shower.

Medical supervision and vaccination programs should be carried out for laboratory staff and technical personnel by carrying out risk assessments against infectious agents used. If necessary, base serum samples should be stored (13). Situations or accidents that may result in exposure to infectious materials should be notified to the laboratory manager immediately and acted according to the safety manual (13).

All staff should be trained in detail about possible risks and precautions to be taken. Biological materials to be taken out of the laboratory must be placed in unbreakable and sealed two nested separate boxes and the outer surface of boxes must be decontaminated. Cages and other laboratory equipment must be autoclaved before washing. The autoclave system must be sealed with a double-cover and be locked until the decontamination process is finished (13,19).

3. Medical Waste Disposal

The wastes generated in health institutions are not only of domestic nature; it is also produced medical and infectious, chemical, and radioactive wastes (22,23). The term medical waste includes all wastes produced by health institutions, research facilities, and laboratories and must be disposed of regularly in order to protect employees and the environment (22).

According to the Regulation on the Control of Medical Wastes, among the health institutions that cause waste as a result of their activities in our country, institutions that conduct research and experiments on animals are considered as "health institutions that produce a moderate amount of waste". Municipalities are responsible for the disposal of medical wastes by sterilization, rendering them harmless, incineration, or storage (24). The removal of radioactive wastes is carried out within the framework of the provisions of the regulation on the Turkish Atomic Energy Agency Law No. 2690 dated 9/7/1982.

According to the Medical Waste Control Regulation of the Ministry of Environment and Forestry, wastes are classified as follows (24).

a. Domestic waste

- General waste and packaging waste.

b. Medical wastes

- Infectious wastes; microbiological laboratory wastes (culture and stocks, infectious body fluids, serological wastes, other contaminated laboratory wastes (lam-lamella, pipette, petri, etc.), blood-blood products and objects contaminated with them, used surgical clothes (cloth, gown, gloves), dialysis wastes (wastewater and equipment), quarantine wastes, air filters containing bacteria and viruses, infected animal carcasses, organ parts, blood and all objects in contact with them.
- Pathological wastes; It consists of various body parts originating from places such as operating rooms, morgue, autopsy, forensic medicine.
- Sharp object wastes; syringe needle, other needle-containing cutters, scalpel, lam-lamella, glass pasteur pipette, other broken glass, etc.

c. Hazardous wastes

-Hazardous chemicals; cytotoxic drugs, amalgam wastes, genotoxic and cytotoxic wastes, pharmaceutical wastes, wastes containing heavy metals, pressure vessels.

d. Radioactive wastes:
- Wastes collected and disposed of in accordance with the provisions of the Turkish Atomic Energy Agency legislation.

The methods used for the disposal of medical wastes are briefly incineration, sanitary storage, sterilization (autoclave, rotoclave, hydroclave, and microwave sterilization), disinfection (with chemical, high-temperature steam, and dry heat). Although incineration is the most effective and safe method among these methods, it causes environmental pollution when it is done without a suitable filter system. Therefore, it was decided to use methods such as sterilization other than incineration with a circular published following this (25).

Another important point to be considered in the disposal of medical wastes is that they are collected in separate bags, independent of household wastes and according to their types. According to the Medical Waste Control Regulation in our country, medical wastes must be put in red-colored bags, packaging wastes in blue-colored bags, and domestic wastes in black-colored bags (25). Liquid medical wastes should also be condensed and bagged with suitable absorbent materials.

Sharp object wastes should be collected in boxes or containers made of tear-proof, shatter-proof, and explosion-proof, waterproof and impermeable, impossible to open and mix, or made of laminated cardboard with the same properties. It should be written on "Attention! Sharp and Penetrating Medical Waste. The container should be filled by ¾ ratio with sharp object wastes, its mouth should be closed and placed in a red plastic bag.

All biological materials of the animal (carrion, tissue, blood, urine, feces, saliva, other body fluids) should be considered as potential sources of infection and should be evaluated as medical waste and placed in red plastic bags. Some materials related to animal experiments must be autoclaved before disposal. If it is not possible to remove the medical waste from the work area on a daily, it should be kept in cold storage (26,27,28). Cleaning personnel assigned to transport medical wastes within the unit are required to wear boots and special protective orange-colored clothes, use gloves, protective glasses, and masks (25).

CONCLUSION

As a result, if attention is paid to OHS implementation principles as below in experimental animals laboratories with many risks, it can be ensured that a safety culture is established and possible risks are minimized.
- Appropriate work placement in the laboratory,
- Determination of laboratory environment factors (physical, chemical, biological, and psychosocial) and risks,
- Providing training on possible hazards according to the laboratory biosafety level,
- Raising awareness by providing occupational health training,
- Intermittent health checking and immunizations of laboratory workers and recording them.

Conflict of interest
No conflict of interest was declared by the authors.

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