ISSN No:-2456-2165

Animal Biosafety using ABSL-3: A Review

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DOI: 10.29322/IJSRP.X.X.2018.pXXXX
http://dx.doi.org/10.29322/IJSRP.X.X.2018.pXXXX

Abstract- Animals are important for the study of diseases as they help discovery of new drugs with prone to testing. Experimenting on animals involves a high risk of spread of infection as high as the risk 3 factor, due to which they are conducted in ABSL-3 units. The lab practices are strengthened to ensure safety and reliability of results. Certain factors affecting the results and safety issues can be fixed by following good management practices to obtain accurate scientific data without any damage.

Keywords:- *ABSL-3; Scientific Data ; Management.*

I. INTRODUCTION

Animal models are important in the study of large-scale infecting diseases and helpful in the developing vaccines. The testing of public health animal of these highly contagious agents must be performed at the ABSL-3 facility. Dealing with the practical issues of conducting animal experiments is very important from the point of view of data quality of biological safety. The paper discusses about safety issues, factors affecting the laboratory animals and the management practices required to waive it off.

II. COMBINATION OF BIOSAFETY, HEALTHCARE AND EXPERIMENTS

The main usage of ABSL-3 Animal Testing Management is to ensure reliable information about animal testing and to ensure safety.

Animal welfare is closely related to the quality of science and welfare conditions have a positive effect on the reliability of scientific information. The well-being of the experimental animal requires maintaining the physical and psychological well-being of the animal by creating living conditions suitable for its nature and alleviating as much as possible the stress and pain of the animal during the experiments. Reducing stress and pain in animals can lead to decreased aggression, while the advantages include reductions in animal scratches and bites as well as aerosol emissions, finally increasing the worker safety.

The nonhuman primate (NHP) is one of the most useful laboratory animals for human pathogen experiments with ABSL-3. Dissimilar to the standard individual ventilated isolation cage (IVC) animal biological container for mice, NHP animal cages are rarely adopted to meet experimental requirements. Animal protection cages, which make the care and handling of animals demanding, cannot be used. The most important barrier to worker protection is Personal protective equipment (PPE). Usage of personal protective equipment in ABSL-3 conditions may limit the worker's vision and skillfulness. Therefore, the risk of injury increases when workers use needles and other sharp tools during procedures. So standard operating procedures (SOPs) and training programs should be optimized to improve the accuracy and stability of procedures adapted to his specific PPE requirements.

III. DESCRIPTION OF FEW SAFETY ISSUES INVOLVING LABORATORY ANIMALS

If cage lids and doors are not properly sealed, infectious animals could possibly try escaping, which in turn poses a potential danger to humans as well as the environment. Few invasive procedures can easily overreact if animals are not adequately sedated with analgesics, anesthetics and tranquillizers. The workers could be scratched or bitten by infected animals in the laboratory. The specific animal room is the primary barrier to biological containment in experiments involving large animals such as dairy, cattle and horses. Workers who enter the space, specifically within the confined space of her ABSL-3 containment, by exceeding the safe "flight distance" of the animal were left feeling trapped and with no means of escape. In these situations, animals may exhibit aggressive behavior such as biting, scratching, and kicking lab staff and workers' safety issues related to harmful microorganisms include infectious aerosols that can be easily generated from infected animal skin and the fur while handling animals, shifting cages, or during disposal of bedding used.

Razor-Sharp instruments such as needles, knives, and scissors are commonly used in animal experiments, including but not limited to animal testing, blood collection, sampling, in vivo detection, biopsy, anesthesia, euthanasia, dissection, etc. Workers can be injured or exposed to pathogens by contaminated sharps. During in vivo experiments and dissections, workers can be exposed to animal infectious agents such as blood, urine, feces, nasopharyngeal swabs, specimens containing bacteria and viruses, and body fluids and organs of infected animals. These infectious materials

pose potential hazards to workers and the environment. Waste such as animal litter, pathogen-laden media, and infected animal carcasses pose a high risk.

Infectious substances pose a risk to staff and environmental biosecurity if accidentally spilled or splashed onto lab benches or floors by researchers. Some of the samples taken from infected animals can be evaluated within ABSL-3, while others must be transferred from ABSL-3 for detection. Failure to safely remove specimens from ABSL-3 poses a potential hazard to personnel and the environment. An infected animal may need to be transferred from the animal room to a dedicated treatment or dissection room within her ABSL-3 for proper in vivo examination or dissection. During the transportation of animals, personnel and the environment can be exposed to pathogens.

For some experiments, special equipment such as X-ray, PET/CT, and NMR equipment can be installed within the ABSL-3 facility. These devices can generate ionizing and radioactive radiation and the associated physical safety. issues cannot be ignored.

X-ray, CT, and other imaging devices are used in animal studies to provide in vivo imaging data. For example, in monkey models used to study SARS-CoV, both chest X-rays and CT scans image lesions in the lungs. Workers exposed to X-rays from imaging equipment can be at risk for skin, hematopoiesis, and bowel damage.

Anesthetics are often used in animal experiments. Long-term exposure to anesthetics can cause damage to the liver, kidneys, nervous system, and reproductive system.

IV. FACTORS AFFECTING ANIMAL EXPERIMENT RESULTS:

Different animal species have different anatomical and pathophysiological characteristics. Different species respond differently to test substances. The animal's sex, age, weight, and physiological health may also affect test results. Healthy laboratory animals tolerate a greater variety of stimuli than unhealthy animals. Environmental factors in livestock farming, such as temperature, humidity, air exchange rate, air purity, light, and noise, affect the health of experimental animals. Proper nutrition is fundamental to growth, development, and improved disease resistance. Results are unreliable if test animals are malnourished.

Personnel involved in animal experiments must have specific knowledge and skills, such as animal model development, animal selection, animal grouping, animal capture, restraint, and animal species-specific techniques is required. Blood draw, sampling, anesthesia, surgery, necropsy, pathological biopsy. Appropriate surgical methods and proficient technique are also important to obtain reliable experimental data. Furthermore, experiments have shown that experimental animals' body temperature, blood pressure, heart rate, blood sugar, basal metabolic rate, hormone secretion, central neurotransmitters, and physiologically active substances in blood, urine, and saliva all show changes in circadian rhythms.

V. ANIMAL EXPERIMENT MANAGEMENT PRACTICES:

Inspection of the animal use register: The Institutional Biosafety Committee (IBC) and the Institutional Animal Care and Use Committee (IACUC) are responsible for ensuring the "biological safety" and "quality of science-based data" of ABSL-3 animal research activities. Before starting a study, the Principal Investigator (PI) of the study must complete an Animal Use Protocol (AUP) and submit it to the IACUC and IBC for review. The project will not begin until the IACUC and IBC approve the AUP. The main control points of the IACUC are the same as in standard animal experiments.

The main control points of the IBC are:

The process of training materials includes biosecurity systems, laboratory knowledge, animal husbandry practices, laboratory animal technical procedures (especially for research animal species), and animal protection.

Laboratory animals must be obtained from a laboratory animal supplier authorized to do so. Some of the educated suppliers provide genetic background, microbiology of animal and the parasite quality certificates so as to make sure that animals are healthy and free of zoonotic diseases. Laboratory animals must be quarantined upon arrival at the facility with aseptic conditions. In the time of isolation period, veterinarians perform clinical observations and tests to ensure that the animals are healthy and suitable for testing. When animals are brought into the animal room as part of ABSL-3, are kept to undergo a certain period of acclimatization to allow them to adapt to a new living environment condition. Sometimes the negative pressure in a new cage and biological isolation decreases the reliability of test results.

Animal care activities primarily include feeding animals, providing drinking water to animals, changing beds/cages/water bottles, cleaning/disinfecting storage areas and cages, disposing of animal waste, and it also includes health care. To avoid cross-contamination in the lab animals in the sham group should be treated first and animals in the infected group later.Cage doors or covers should always be fitted with safety devices to prevent animals (such as monkeys) from accidentally opening and escaping the cage. Workers must protect cages by using cover cages and lock cage doors to prevent infected animals from escaping.Access to ABSL-3 facilities is restricted. Only authorized personnel may enter areas of ABSL-3, who know and follow standard operating procedures (SOPs) for entering, exiting, and donning PPE.

Sharps are often used in animal experiments, such as blood sampling and autopsies. When installing ABSL-3, use sprinklers with protective caps. Place used disposable needles in a puncture-resistant container for disposal. For ABSL-3, needle retention in mice is not recommended. Whenever possible, surgical instruments such as forceps and scissors should be blunt. Avoid using glassware.

During animal experiments, animals must be restrained either physically or chemically by using sedatives, and the operator must wear appropriate personal protective equipment to prevent them from being bitten or scratched. A minimal of two workers must go into the animal room and work together to avoid animal attacks. For social animals such as monkeys, it is important not only to provide animals with non-social enrichment such as puzzle devices, resting places and monkey mirrors but also social enrichment.

All solid and liquid waste from animal testing must be decontaminated by using methods like autoclaving before removal from the ABSL-3 isolation area. Laboratories must prepare Material Safety Data Sheets (MSDS) for chemical disinfectants used in ABSL-3 facilities. These safety cards and data sheets must contain detailed information about potential hazards that may happen and the required first aid equipment for it. Workers must wear personal protective equipment to avoid UV radiation. Equipment such as X-ray and CT must be installed in a room with a safety fence. The radioactive waste cannot be autoclaved from the ABSL-3 facility until the radioactivity of the waste has decreased to an acceptable level. Animal remains containing radioactive material must first be placed in special radioactive plastic bags where the corpses are dried in special ovens at a temperature of 60-70 °C. The dried corpses can then be processed according to radioactive waste management practices.

VI. CONCLUSION

The management goal of the ABSL-3 laboratory is to ensure the safety of animal experiments using highly infectious pathogens and to obtain high-quality experimental data. Achieving this goal requires establishing a holistic biosecurity approach that considers both broader safety of the workers as well as the environment also including the data quality. These aspects are critical for successful animal studies with ABSL-3. Measures should be taken for AUP screening, laboratory animal management and safety management, equipment management and staff training. All these measures ensure both the safety of ABSL-3 and the reliability of the scientific results.

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