

A Review on Animal Utilization in Toxicology and Safety Assessment and its Ethical Guidelines

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Abstract: *Animal studies play a crucial role in evaluating the safety and toxicity of pharmaceuticals, chemicals, and consumer products. In toxicology and safety assessment, animal models are used to predict potential adverse effects in humans, ensuring the protection of public health. This topic explores the use of animal studies in identifying toxicological profiles, assessing risk, and informing regulatory decisions.*

Animal models have been extensively used in toxicology and safety assessment to evaluate the potential risks of chemicals, drugs, and other substances on human health and the environment. The use of animals in toxicology studies provides valuable information on the absorption, distribution, metabolism, and excretion (ADME) of substances, as well as their potential toxicity and carcinogenicity.

Importance of Animal Models

1. Predicting human toxicity: Animal studies help predict potential human toxicity and identify potential health risks.

2. Evaluating safety: Animal studies evaluate the safety of substances for human use and environmental release.

3. Developing new drugs: Animal models are used to develop and test new drugs, vaccines, and therapies.

Keywords: Toxicology safety assessment, animal studies, in vivo models, human health risk, regulatory frameworks.

I. INTRODUCTION

- Preclinical trials are studies conducted on animals to evaluate medications, procedures, or other medical treatments.
- Animals are frequently used in laboratories for experimental purposes related to drug testing for human welfare, new drug information, and drug discovery.
- Due to the animal's biological resemblance to humans, its DNA was 98% similar to that of humans. • Preclinical and nonclinical investigations are a phase of research in medication development that starts before clinical trials ~tasting in humans} may start. It is during this phase that crucial data on drug safety, iterative testing, and feasibility is gathered.
- Researchers must determine whether a medicine has the potential to cause serious harm, often known as toxicity, before testing it on humans.
- Preclinical research comes in two varieties.
- There are two types of preclinical research are :
 - 1] In Vitro [Outside the living]
 - 2] In Vivo [Inside the living]
- In the following information of mostly used animal in laboratory and its experimental used, metabolism study, various committees likes.
- CPCSEA [Committee For The Purpose Of Control And Supervision Of Experiment On Animal], IAEC [Institutional Animal Ethics Committee].

Preclinical trials are a crucial step in the development of new drugs, medical devices, and other treatments. Here are the types of preclinical trials:

In Vitro Studies

1. Cell culture studies: Testing the effects of a substance on cells in a laboratory dish.
2. Biochemical assays: Measuring the activity of enzymes, receptors, or other biomolecules.

In Vivo Studies

1. Acute toxicity studies: Assessing the short-term effects of a substance on animals.
2. Subchronic toxicity studies: Evaluating the effects of repeated exposure to a substance over several weeks or months.
3. Chronic toxicity studies: Investigating the long-term effects of exposure to a substance over several months or years.
4. Carcinogenicity studies: Assessing the potential of a substance to cause cancer.

Specialized Studies

1. Pharmacokinetic studies: Investigating the absorption, distribution, metabolism, and excretion of a substance.
2. Pharmacodynamic studies: Evaluating the effects of a substance on the body.
3. Toxicokinetic studies: Assessing the relationship between the dose of a substance and its toxic effects.
4. Reproductive toxicity studies: Investigating the potential effects of a substance on fertility and development.
5. Neurotoxicity studies: Evaluating the potential effects of a substance on the nervous system.

Alternative Methods

1. Computer simulations: Using computational models to predict the behavior of a substance.
2. In silico studies: Conducting studies using computer-based models and simulations.
3. In vitro-in vivo correlation studies: Comparing the results of in vitro studies with those of in vivo studies.

These types of preclinical trials help to ensure the safety and efficacy of new treatments before they are tested in humans.

ANIMAL USED IN PRE-CLINICAL INVESTIGATION

Since people first began searching for solutions to prevent and treat illnesses, animals have been used in research and education. The use of animals in research made the majority of today's pharmacological discoveries possible. The word "animal experimentation" refers to the use of animals in training, research, and educational settings.

Despite having distinct connotations, the terms "animal testing," "animal experimentation," "animal research," "in vivo testing," and "vivisection" are sometimes used interchangeably.

Cutting into or dissecting a living animal is known as "vivisection," a phrase that is favored by individuals who are against using animals in research. Scientists favor using the phrase "animal experimentation."

1.FROG:-



(Adult Weight 50-100gm)

Biological Source: Rana Tigrina Common Strain .

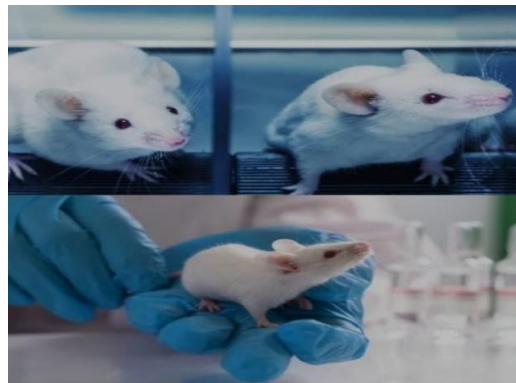
Used: Rana esculenta, Rana pipiens and Rana temporaria.

Specific Characteristics: Frog is a cold blooded amphibian. It has three chambers in its heart, two auricles and one ventricle.

Used in Preclinical :

- Study of isolated tissue like rectus, abdominis muscle, heart, sciatic nerve preparation etc. To study the effect of drug acting on central nervous system, neuromuscular junction and heart. Study of a drug on the CNS, the study of isolated tissue such as rectus abdominis muscle.

2. RAT



(Adult Weight 200-250gm)

Biological Name: Rattus Norvegicus.

Common Strain Used: Albino rats of wistar strain, Sprague-Dawley, Wistar Kyoto, Lewis, and Porton.

Specific Characteristics: Rat is a warm blooded rodent. It can't vomit and does not possess the vomiting center. It has no tonsil and gallbladder in its body. Hence it can't be used in screening of the drugs having activities on vomiting center, or gall bladder. Rat is omnivorous animal. It shows resistance to the effects of cardiac glycosides.

Uses in experimental pharmacology:

- Psychopharmacological Studies.
- Bioassay of various hormones such as insulin, oxytocin, vasopressin etc
- Study of estrus cycle, mating behaviour and lactation. Studies on isolated tissue preparations like uterus, stomach, vasdeferens, anococcygeus muscle, fundus strip, aortic strip, heart rate etc.

3. GUINEA PIG:-



(Adult Weight 400-600gm)

Biological name: Cavia Procellus

Specific Characteristics

Particulars:

It is a submissive animal. It is prone to allergy and TB. It is extremely susceptible to penicillin and histamine. Dietary exogenous ascorbic acid was necessary

The guinea pig is a rodent with warm blood. Even its name has come to connote an experimental animal.

Application in Pharmacological Experiments:

- Assessing bronchodilators. Immunological and anaphylactic investigations.
- Histamine and anti-histamine research.
- A digitalis bioassay.
- Assessment of local anesthetics.
- Due to the sensitive cochlea, hearing tests are conducted.

4. MOUSE:-



(Adult Weight 20-25gm)

Biological name: mus musculus.

Common Strain Used:

Swiss albino, laca, and balb-c are common strains Particular traits.

The most often utilized animal in various toxicity investigations is the mouse. It is a rodent with warm blood. Mice are extremely susceptible to hexobarbitone's sedative effects. They are small, inexpensive, and manageable.

Used in Experimental Pharmacology

- In experimental pharmacology Insulin bioassay.
- Teratogenic and toxicological research.
- Analgesic and anticonvulsant screening.
- Chemotherapeutic agent screening.

5. RABBIT:-



(Adult Weight 1.5-3kg)

Biological Name: *Oryctolagus cuniculus*.

Strains Used: New Zealand White, Himalayan Black.

Specific Features:-

It is a large-eared, docile mammal. White rabbits from New Zealand are typically used. The rabbit is a warm-blooded mammal. Some rabbit strains have higher blood levels of the atropinase enzyme, which makes them resistant to the effects of atropine. In this species, coitus causes females to secrete leutenizing hormone (LH), which triggers ovulation. Such ovulation is known to be blocked by the hormone progesterone

Pharmacological Experiments:

- Testing for pyrogen.
- Tests for irritation and the bioassay of sex hormones and anti-diabetics.
- Examining medications used to treat glaucoma.
- Identifying substances that alter capillary permeability

6. HAMSTER:-



Biological Name: *Mesocricetus Auratus* and *Cricetulus Griseus*

Specific Characteristics: They are characterised by their short torso, short legs, and short tail. Dense, short, silky fur covers the loose skin. The cheeks have noticeable pouches that reach the shoulder area.

Utilisation in Experimental Pharmacology:

Due to their low chromosome count, Chinese hamsters are beneficial for study on radiation, tissue culture, genetics, and cytology.

Diabetes mellitus research.

Studies pertaining to immunology, virology, and implantation.

CPCSEA

Committee for the Purpose of Control and Supervision of Experiment on Animal

- Formed in 1964.
- Revived in 1998 ,under the committed chairpersonship of Meneka Gandhi Head quarters at Chennai

Joint commissioner Dr.S.k.Dukka.

Statutory body formed by the act of the Indian Parliament under the **Prevention cruelty to of Animal Act ,1960.**

- This committee is composed of
 - ◆ Member of the scientific community
 - ◆ Regulatory authorities
 - ◆ Animal activists
 - ◆ The committee has 10 experts and 3 official member

The role of CPCSEA nominees are wellbeing and welfare of the animal house or kept for experiment/breeding.

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Function:

- Facilities in animal houses are inspected and approved. The institutional animal ethics committee is registered with Pop. [IAEC] For bleeding or animal experimentation.
- CPCSEA nominees are appointed to IAECs.
- Authorization for large animal experiments
- Experiments are inspected and, if in violation, prohibited.
- The suggestion to import animals for research purposes.

Objectives:

- To encourage humane treatment of research animals
- To encourage humane treatment of research animals.
- To offer guidelines that will improve the welfare of animals and the caliber of research.

Need of CPCSEA:-

- To guarantee that laboratory animals are kept in good condition and that experiments are carried out in compliance with ethical standards.
- To encourage humane treatment of animals employed in behavioral and biomedical studies. To improve the quality and well-being of animals.
- To upgrade facilities for laboratory animals The biological knowledge of Duennas that applies to both humans and animals.

CPCSEA GUIDELINES FOR LABORATORY ANIMALS FACILITY

❖ Maintenance of laboratory animal as per CPCSEA guideline

- This guideline aims to encourage women to be mindful of the use of animals in behavioral and biological research and testing.
- To prevent needless suffering prior to, during, and following the experiment.
- To offer recommendations for:

o Housing, upkeep, breeding, and care.

o The origin of the test animals Appropriate experimental methods for euthanasia and anesthesia

It is essential to take care of below mentioned point regarding the experimentation on animal. As per CPCSEA guideline.

• Veterinary care:

- Provided by veterinarian .
- Daily observation of animals.
- Reviewing Protocols and proposals.
- Establishment of appropriate policies and procedures for animal husbandry.

Methods to conduct preclinical trials:

Study Design

- 1. Dose-Response Study:** Evaluating the effects of different doses of a substance.
- 2. Time-Course Study:** Assessing the effects of a substance over time.
- 3. Controlled Study:** Comparing the effects of a substance to a control group.

In Vitro Methods

- 1. Cell Culture:** Growing cells in a laboratory dish to test the effects of a substance.

- Biochemical Assays:** Measuring the activity of enzymes, receptors, or other biomolecules.
- Tissue Engineering:** Creating artificial tissues to test the effects of a substance.

In Vivo Methods

- Animal Models:** Using animals to test the effects of a substance.
- Surgery:** Performing surgical procedures to test the effects of a substance.
- Imaging Techniques:** Using imaging techniques such as MRI or CT scans to visualize the effects of a substance.

Data Analysis

- Statistical Analysis:** Using statistical methods to analyze data.
- Data Visualization:** Using graphs and charts to visualize data.
- Toxicokinetic Analysis:** Analyzing the absorption, distribution, metabolism, and excretion of a substance.

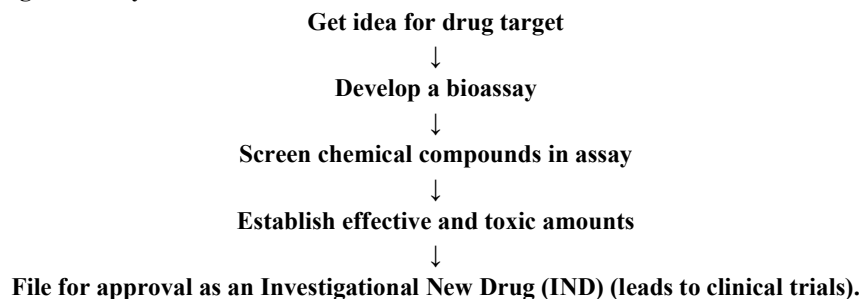
Good Laboratory Practice (GLP)

- Standard Operating Procedures (SOPs):** Following established SOPs.
- Quality Control:** Ensuring the quality of data and materials.
- Documentation:** Maintaining accurate and detailed records.

Regulatory Compliance

- ICH Guidelines:** Following International Conference on Harmonisation (ICH) guidelines.
- FDA Regulations:** Complying with US Food and Drug Administration (FDA) regulations.
- OECD Guidelines:** Following Organisation for Economic Co-operation and Development (OECD) guidelines.

Steps to New Drug Discovery Pre-Clinical Trials



II. CONCLUSION

As the laboratory safety is an essential factor when performing preclinical trials. It is important to know about laboratory precaution & safety guidelines.

Standard precautions are the work practices required to achieve basic level of infection, prevention and control CPCSEA and IAEC guidelines are also help to control or maintain standard during preclinical study.

During preclinical study, animal care must be taken for the study of animal care, guidelines is important. Animal experimentation has enormously benefited humans as well as animals. In the post and will continue to be necessary for clinical and basic research in the future.

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