Use of Laboratory Animals in Medical Research: A Brief Overview

Manal E Elsawaf*

Professor of Human Anatomy and Embryology, Faculty of Medicine, Tanta University, Egypt

*Corresponding Author: Manal E Elsawaf, Professor of Human Anatomy and Embryology, Faculty of Medicine, Tanta University, Egypt.

Abstract

Scientists have started to use animals in their researches since centuries. Animals, particularly mammals, may mimic the development, behaviour and biology of humans in many respects. Every year, tens of millions of animals are used as candidates for medical research all over the world. The pathology and progress of multiple diseases have been understood through animal testing. The rapid advancement of medicine and many discoveries have been attributed to these experiments. Not all animals are suitable candidates for the use in different experiments, and hence, choosing an animal model must parallels the biology of the required study. Recently, transgenic animals have been produced to simulate human diseases which do not naturally affect them. Multiple institutions concerned with animal rights and welfare have recommended use of alternative non-animal methods whenever possible, minimizing the number of animals used in an experiment to the least and using of methods decreasing pain and distress to the animals. This brief article overviews the importance of use of animals in advancement of medicine and its reflection on both human and animal health. It also puts a focus on the standards for animal care and animal welfare on use of animals in laboratory researches.

Keywords: Alternative Methods; Animal Model; Animal Rights; Laboratory Animals; Medical Research

The mission of medicine is to alleviate pain, treat diseases, increase life span and improve quality of life of humans. For the sake of this mission, medical researches have been done all over the world. The purposes of these medical researches are to study normal biology of body cells and organs, discovery of pathology and complications of diseases and to evaluate drug efficacy as well as drug side effects. Many methods are used in medical research including animal testing, *in vitro* studies, tissue culture, computer simulations and human studies. The most important method is the use of laboratory animals which is usually conducted in universities, medical schools and pharmaceutical companies [1]. Around 100 million animals are used all over the world in scientific researches every year. Most animals are used in only one procedure and are less commonly reused. Multiple vertebrates are used in medical research with the use of mammals on the top. As humans belong to mammals, they share the same organs like heart, lungs, brain, liver and other organs. Besides, they share most of their genes. Developmental and biological processes are almost alike. Mice and rats represent up to 90% of animals used in medical research. Their short life span and rapid breeding allow us to understand effects on future generations. The other 10% includes larger animals like guinea pigs, pigs, dogs, monkeys, rabbits, hamsters and sheep [2].

The debate about the use of experimental animals has been raised a long time ago. One of the objections against their use argued that it is not fair to harm animals for the benefit of humans. Others suggested that vivisection of animals might alter their physiology leading to unreliable results. In response to these objections, several organizations were set up to regulate use of animals in research [3]. Accordingly, the use of animals in research must follow the ethics which include the animal rights. The scientists have to confirm that there is no alternative non-animal method can fulfil their research. They should demonstrate how they would decrease any possible pain or suffering to the animal. The number of animals must be decreased to the minimum number that can give reliable results. Many laws and regulations have been formulated to govern the animal use in laboratory researches [4]. In Egypt, all medical colleges start to use alternatives to ani-

mal experiments in the undergraduate medical course. Besides, ethical research committees have been constructed in almost all medical schools to ensure that researches follow the national standards for the use and care of laboratory animals. Multiple institutes concerned with animal rights and animal welfare approved 3Rs for the use of animals in research work; replacement, reduction and refinement.

These words can be defined as follows:

1. **Replacement:** whenever possible, the use of a non-animal alternative (e.g. computer modelling) is preferable if the same scientific aims can be gained.
2. **Reduction:** researchers must use the least number of animals that can give reliable results.
3. **Refinement:** it is preferable to use methods that minimize pain and suffering of animals and to ensure animal welfare [5].

Choosing a specific animal model for a particular research depends upon the type of the experiment. Humans and animals share multiple illnesses, and consequently animals can act as models for the study of human diseases. Researchers choose the species that best parallels the biology of what they want to study. For example, sheep and horses can provide a model to study osteoarthritis [6]. Pigs offer a model for research on skin problems [7]. Dogs may develop diseases like cancer, diabetes, cataracts, ulcers and haemophilia and aging diseases, which make them natural candidates for research into these disorders [8,9]. Dogs, cats, and non-human primates are suitable for the study of heart disease, neurological disorders, AIDS and studies of Ebola virus. Rabbits are used in eye irritancy tests because they lack eye pigment. They also used in production of polyclonal antibodies [10]. Although rabbits are the host of choice for studying schisto-somiasis japonica, yet they are not good hosts for *S. mansoni*. The adult *S. mansoni* worms are eliminated early and the eggs do not mature in the tissues or even do not appear in the stools after cercarial exposure in rabbits. On the other hand, mice provide a good model used to study *S. mansoni* [11]. Also, mice are the best model for studying neural tube defects [12]. Many other animal models were recorded in the literature. Recent genetic technology advances have developed transgenic animals where new genes are inserted into their DNA. Thus, these transgenic animals can develop human diseases which do not naturally affect them. This method has enabled the researchers to model many human diseases which were previously difficult to study [10,13].

Studying disease mechanisms in animal models leads directly to the development of new technologies and medicines that benefit both humans and animals. Each year there are breakthroughs and new discoveries of new methods of treatment and new generations of drugs. There is a strong relationship between rapid progress in experiments on animals and progress in clinical medicine. The greatest drug discoveries in the 19th and 20th centuries were achieved due to the use of animals. For example in the 1880s, horses were used for production of diphtheria antitoxin. In 1922, Insulin was first isolated from dogs to start a new era in treatment of diabetes. In the 1970s, the use of armadillos developed the antibiotic treatment and vaccines for leprosy. Implants as heart pacemakers or artificial hips and diagnostic tools as scanners were developed and tested for safety and efficacy in animals before their use in humans. Many surgical procedures, such as open heart surgery and heart transplants, rely on methods and equipment that were developed using animals [2,14].

Conclusion

In conclusion, animal studies are crucial for best knowledge about human and even animal diseases. Use of animals in testing drug efficacy and safety is mandatory before application of this drug in clinical trials in humans. Whenever possible, it is preferred to use alternative non-animal methods if the same aims can be achieved. Comprehensive understanding of cell and organ function of different animals helps in choosing the best animal model for a particular experiment. The national standards for the use and care of laboratory animals must be followed in all institutions dealing with animal researches.

Bibliography

1. Badyal D., *et al*. "Student evaluation of teaching and assessment methods in pharmacology". *Indian Journal of Pharmacology* 42.2 (2010): 87-89.

2. Badyal D and Desai C. "Animal use in pharmacology education and research: The changing scenario". *Indian Journal of Pharmacology* 46.3 (2014): 257-265.

3. Nicoll CS. "A physiologist's views on the animal rights/liberation movement". *The Physiologist* 34.6 (1991): 303-315.

4. Dikshit RK. "Animal experiments: Confusion, contradiction, and controversy". *Indian Journal of Pharmacology* 44.6 (2012): 661-662.

5. Guhad F. "Introduction to the 3 Rs (refinement, reduction and replacement)". *Contemporary Topics in Laboratory Animal Science* 44.2 (2005): 58-59.

6. Martine Cohen S., *et al*. "Animal models of osteoarthritis for the understanding of the bone contribution". *BoneKey Reports* 2 (2013): 422.

7. Summerfield A., *et al*. "The immunology of the porcine skin and its value as a model for human skin". *Molecular Immunology* 66.1 (2015):14-21.

8. Cotman CW and Head E. "The canine (dog) model of human aging and disease: dietary, environmental and immunotherapy approaches". *Journal of Alzheimer's Disease* 15.4 (2008): 685-707.

9. Rowell JL., *et al*. "Dog models of naturally occurring cancer". *Trends in Molecular Medicine* 17.7 (2011): 380-388.

10. Wilson-Sanders SE. "Invertebrate models for biomedical research, testing and education". *ILAR Journal* 52.2 (2011): 126-152.

11. Cheever AW., *et al*. "Experimental models of schistosoma mansoni infection". *Memórias do Instituto Oswaldo Cruz* 97.7 (2002): 917-940.

12. Juriloff DM and Harris MJ. "Animal models of neural tube defects". *Mental Retardation and Developmental Disabilities Research Reviews* 4.4 (1998): 254-263.

13. Katarzyna B., *et al*. "Models in the research process of psoriasis". *International Journal of Molecular Sciences* 18.12 (2017): 2514.

14. Abarbanell AM., *et al*. "Animal models of myocardial and vascular injury". *Journal of Surgical Research* 162.2 (2010): 239-249.