



A Note on Toxicological Studies

Gassama R

Department of Pharmacology, Université Paris-Saclay, France

DESCRIPTION

Toxicology is a scientific study that deals with the analysis of the harmful effects of chemical compounds on living organisms as well as the technique of identifying and treating toxins and toxicants exposures. Poison is any hazardous chemical when used in any way, whether purposefully or unintentionally, can cause major health problems. Toxicologists are professionals who specialized in the field of toxicology.

Toxicologists are primarily interested in discovering about the following topics:

- Detection of poison
- Occurrence of poison
- poison properties
- Effects of poison
- poison treatment
- poison regulation

The major aim of toxicology research is to safeguard individuals and the environment from the harmful effects of toxicants. This research will eventually lead to the development of better, more innovative, and more selective pharmacological treatments to cure a variety of disorders, such as cancer, with a lower risk of toxicity to the human body.

Toxicology testing methods

Toxicology studies are done by 3 methods.

1. *In-vivo* (using animals)
2. *In-vitro* (testing on isolated cells or tissues)
3. *In-silico* (computer simulation)

***In-vivo* studies:** *In-vivo* toxicity studies are conducted using animals to determine toxic effects. *In-vivo* toxicity studies include:

- Acute systemic toxicity (3 to 14 days)
- Sub-acute toxicity (14 to 30 days)
- Sub-chronic toxicity (longer than 30 days)

Acute systemic toxicity: Acute systemic tests are conducted to identify short-term hazardous effects arise

immediately after a chemical is consumed (oral toxicity tests), absorbed through the skin (dermal toxicity testing), or inhaled (inhalation toxicity tests).

Sub-acute toxicity: Sub-acute toxicity studies are used to investigate a new drug's possible side effects after a two- to four-week treatment interval. Sub-acute toxicity studies are performed to determine dose levels that will be employed in later sub-chronic and chronic toxicity studies.

Sub-chronic toxicity: The purpose of chronic and sub-chronic toxicity studies, like shorter repeated dose toxicity study designs, is to further test hypotheses about mode of action, predict the health effects of the therapeutic entity in human exposure, identify target organs, and categorise the dose-response relationship.

In-vitro studies: *In-vitro* toxicity studies are done using isolated organs and tissues cell cultures. *In-vitro* assays are developed using isolated cell components to evaluate biochemical and functional responses in order to discover the mechanism of action and innovation of various treatments.

Sources of tissues for *in-vitro* methods

- Rodents like rats and mice of both wild and transgenic types are used.
- Human tissues from neural progenitor cells from aborted foetuses and stem cell lines and also from cord blood derived stem cells.

In-vitro methods includes

- In-vitro pyrogen test
- Embryonic stem cell test
- Repeated dose toxicity test
- Carcinogenicity test, etc

In-silico: In-silico techniques relate to approaches or predictions that use computational procedures. In silico methods have the advantage of rapidly predicting a huge number of compounds in a high-throughput mode.

In-silico model includes various methods like

- Computer aided molecular drug design
- Quantitative Structure Activity Relationships (QSAR)
- Computer assisted learning
- Microfluidic chips
- DNA chips
- Computer or mathematical analysis

To decrease the suffering to animals, various alternative methods are introduced, like

- Continued but modified use of animals
- Computerized patient drug databases and virtual drug trails
- Computer models and simulations
- Non-invasive imaging techniques such as MRI's and CT scans
- Micro-dosing

The alternative method, continued but modified use of animals developed 3R strategy.

- R- Refinement

- R- Reduction
- R- Replacement

Refinement: This method refines experimental methods to decrease unnecessary pain and trauma to animals.

Reduction: This method is used to reduce the number of animals used in the experiment.

Replacement: This method is used to replace the use of animals in various experiments. Eg: computer simulation models.

Advantages

- Cruelty- free products are environmentally friendly
- The use of human tissue in toxicity testing is more accurate than in animal models.
- Alternative methods are more reliable than animal tests.