FACT SHEET

Alternatives

With animal-based research so entrenched in our scientific community, one may wonder how medical progress could ever occur without the use of animals – to test new drugs, to determine biological, neurological and pathological processes etc. There are better ways!

A different approach

The move away from animal use in medical research is not simply a matter of replacing such procedures with alternative non-animal methods, but rather, there is a need to re-evaluate the entire process of how we approach medical research.

Far more emphasis needs to be placed on epidemiology, clinical research and autopsies etc. so that we can address the real disease rather than a replica in a model of another species. There are also now revolutionary techniques already underway that do not rely on animal use and are clearly the way forward if we are to truly understand the science of human disease.

Prevention is clearly the best option when it comes to human health. The large majority of illnesses and deaths in our society today are attributable to lifestyle choices rather than to genetic disorders and disease. Heart attack and stroke (atherosclerosis), many cancers, obesity and motor accidents are largely preventable. By placing greater emphasis on diet and lifestyle education our society would enjoy a much higher level of health and longevity.

Epidemiology is the study of human populations and the direct observation of disease progression so that preventative measures can be taken. These population studies have led to a vast knowledge in regards to the causes of many cancers – including the link to smoking, the effect of diet on atherosclerosis, the benefits of a diet rich in fruit and vegetables and reduced salt intake. The analysis of data obtained through epidemiology can also factor in environmental and lifestyle aspects that impact on the disease and recovery. These studies have become vastly more sophisticated as accumulated data can now be stored through computer accessible medical records tracking thousands of patients at various institutions.

Autopsies. Back in the 18th century autopsies provided a huge amount of knowledge about the human body, and disproved much that was learned previously through animal experiments[1]. They are a credible way of determining the cause of illness, revealing undiagnosed findings and making valuable discoveries, however they are no longer routinely performed.

In vitro literally means "in glass" and is an alternative to using live animals in experiments. The advantages of using tissue and cell cultures are that they can be derived from humans (often after death) and so there is no inter-species variation, the cells are the same and so can be compared with other laboratories, and the experiments are quicker, cheaper and more humane. Examples of these methods include the Ames Test, which uses bacteria to test for mutagenicity (which usually correlates to carcinogenicity), growth of human skin cells to test toxicity and the use of human placentas to study a variety of processes[2].

Computer Modelling is used to screen thousands of chemicals by building on the knowledge that we have already obtained about their structure and predicting their likely reaction with living cells. Computers are now able to simulate parts of the human body as mathematical equations. They can also create three-dimensional graphical models of molecules, which will allow the study of their shape and structure. Examples of such programs include DEREK (Deductive Estimation of Risk from Existing Knowledge) - a system developed by Unilever whereby toxicity predictions are made on the basis their chemical structure, and COMPACT, a program used by Surrey University which predicts chemical toxicity based on the chemical's likely interaction with body enzymes[3].

The use of computer modeling means that information can be obtained through comprehensive medical databases rather than having to repeat experiments conducted previously.

New technologies

Despite claims by some researchers that alternative methods are not yet sophisticated enough to replace animal tests, they are certainly more dependable and produce more accurate results than tests on species who differ from humans in their metabolism of toxins, rates of detoxification and protein binding, absorption of chemicals, mechanisms of DNA repair and lifespan – all factors that would have a profound effect on the efficacy of drugs. The following list provides just a snapshot of some of the emerging technologies that will replace outdated and unreliable animal tests.

Genomics – The study of nucleotide sequences, structural genes, regulatory sequences and DNA within the chromosomes of an organism.

Proteomics – Analysis of the expression, functions and interactions of proteins expressed by the genetic material.

Nanotechnology – The science of assembling materials one atom at a time by combining molecular biology, chemistry, physics, engineering, computer science and electronics. It enables scientists to see atoms they are working with and piece them together in different ways. Pharmacogenomics – Using cell-based assays, computer modeling

and innovative technology, it identifies complex patterns of gene variations and enables scientists to classify patient populations according to their own individual response to a drug.

Phage Display – A method of quickly evaluating a huge range of potentially useful antibodies and then producing large quantities of the selected ones. It is the interaction between a virus and a bacteria to produce antibodies, which can be produced in a much shorter time than traditional animal methods.

Microdosing - A method using human volunteers at the earliest stage of drug development. Very small doses of a drug (less than 1% of the active dose) accompanied by radioisotope-14 are given to a healthy volunteer, and with extremely sensitive monitoring devices, the body's response to the drug can be observed safely. There are several ways that the dose can be monitored and these are Accelerator Mass Spectrometry (AMS), Nuclear Magnetic Resonance and Positron Emission Tomography, with AMS being the most popular. It indicates early in the process which drugs are unlikely to be successful and therefore means animals are not being tested for drugs which will not go the distance.

Microfluidic Chips – Microfluidic Chips such as the Toxichip developed by Tyndall National Institute et al. in Cork, Ireland are a microsystem made up of biochip sensors housed in a fluidic platform. The biochip is capable of both optical and electrical analysis and can monitor the effects of toxic compounds on cellular behaviour. The impedance cell-based biosensor systems give insight into the behaviour of cells and parameters such as concentration, growth and alterations in physiology. Human or animal cells are cultured on the biochips and are placed in contact with the test substance in fluid form. The microfluidic platform provides a vehicle for the wash solutions to come into contact with the biochip and attached cells. It also monitors temperature and pH (acidity and alkalinity) as an assay control so that the cellular behaviour monitored is due to presence of chemicals introduced into the platform and not from other outside interferences like temperature or pH changes.

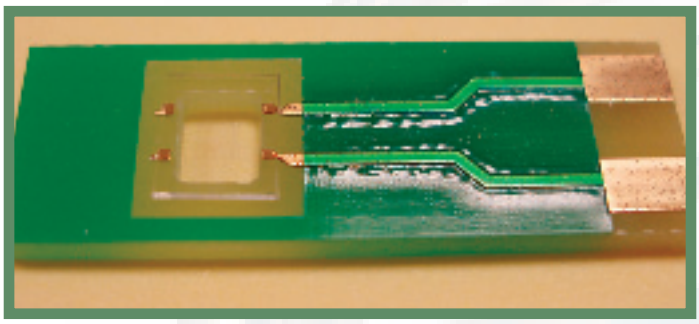

Photo: Toxichip developed by Tyndall National Institute et al.

Human Genome Project

The Human Genome Project (HGP) was initiated in 1990 and was an international 13-year joint effort between the U.S. Department of Energy and the National Institutes of Health. Its goal was to identify, map out and database all of the 30,000 genes present in human DNA, and to determine the sequences of the 3 billion chemical base pairs that make them up.

The Project has cost more than $3,000,000,000 of US Government funding, but has provided researchers with detailed DNA information that will be invaluable in understanding the structure, organization, and function of DNA in chromosomes. This will of course lead to a far greater understanding of hereditary diseases and genetic disorders such as Huntington's disease and Down's syndrome, and the prospect of cures.

According to Eugene Chan, founder of U.S. Genomics, rapid genome sequencing will impact every single element in medicine. "When a person is born, their genome will be scanned, analysed and stored. That information will then be reaccessed later. Healthcare will be cheaper because of the amount of preventative care you can provide having this genetic information. Drugs will be cheaper to develop. And these new therapies are going to be so much more elegant than traditional therapies… What we're going to start seeing with genomics-based medicine is the ability to be able to customize drugs so they will be targeted only to the disease-causing cells and will have only minimal side effects. People will be making fewer doctor visits, they'll be feeling healthier, living longer, and having a better quality of life."[4]

Alternatives Research

A number of non-profit organizations around the world now focus on funding non-animal research:

- The Dr Hadwen Trust
- The Lord Dowding Fund
- The MAWA (Medical Advances Without Animals) Trust in Australia.

References:

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6 "Reducing animal suffering often has the unexpected benefit of yielding more rigorous safety tests" Alan M. Goldberg and Thomas Hartung, Scientific American, Jan 2006.
7 http://iccvam.niehs.nih.gov/