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Pharmaceutical Application of Artificial Organ

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Abstract: *Artificial cells for pharmaceutical and therapeutic applications started as microencapsulation on the micron scale. This has now expanded up to the higher range of macrocapsules and down to the nanometer range of nanocapsules and even to the macromolecular range of cross-linked hemoglobin as blood substitutes. The technology of tissue engineering is a rapidly evolving interdisciplinary field of science that elevates cell-based research from 2D cultures through organoids to whole bionic organs. We also present the possibilities of microfluidic systems, based on the latest reports. We demonstrate the pros and cons of both technologies and indicate their use in the future of medicine.*

Keywords: 3D bioprinting; organ-on-a-chip; bionic tissue; bioink; cell culture

I. INTRODUCTION

Currently, animal testing is the most popular technique for examining an organism's response to a biologically active compound. Researchers have long attempted to develop treatment strategies for naturally occurring sensory dysfunctions and injuries of the nervous system. For example, autologous nerve transplantation or nerve grafting has been considered a gold standard reconstruction technique. Organ-on-a-chip (organ chip) microfluidic culture devices represent one of the recent successes in the search for in vitro human microphysiological systems that can recapitulate organ-level and even organism-level functions. A difficult goal which needs to be achieved is the body-on-a-chip concept, which requires multiple OoC of different cell type or organs to be linked in order to create a system OoC has several applications, but the most important is drug development and the effects that they have on different organs.

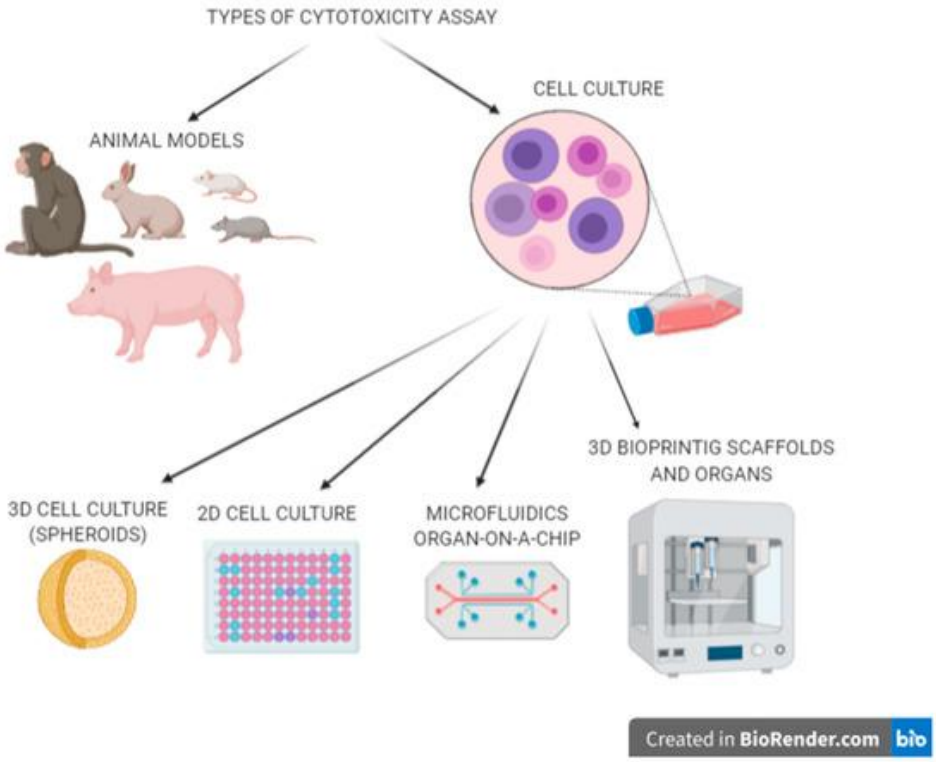

Figure 1. Types of biological materials and techniques used in cytotoxicity assays during potential new drug testing.

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II. ARTIFICIAL ORGANS AND HOW THEY WORK

Artificial sensory organs

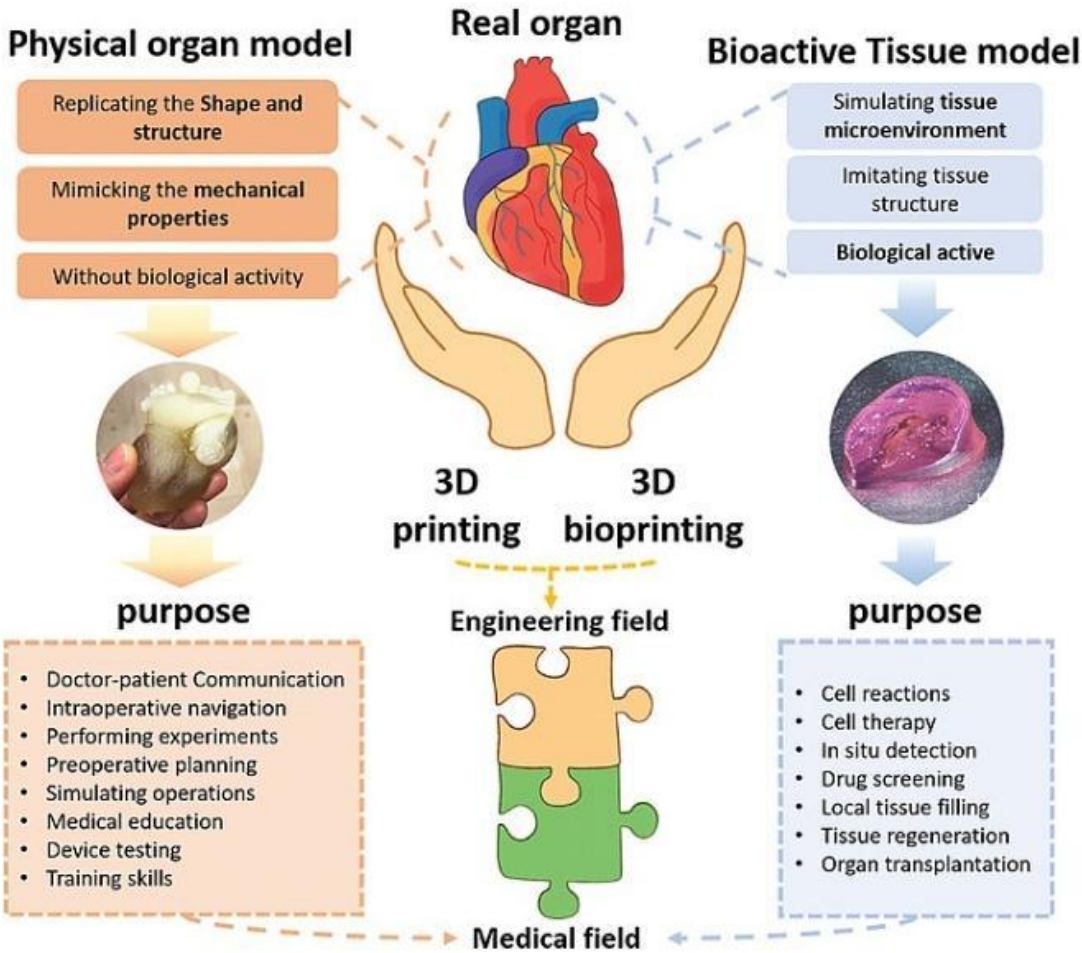
Artificial sensory organs are a prosthetic means of sending visual or auditory information to the brain by electrical stimulation of the optic or auditory nerves to assist visually impaired or hearing-impaired people.Researchers have long attempted to develop treatment strategies for naturally occurring sensory dysfunctions and injuries of the nervous system. For example, autologous nerve transplantation or nerve grafting has been considered a gold standard reconstruction technique.

Artificial kidney and artificial liver

There are many iterations of artificial filtration systems to treat kidney and liver disease. However, external systems such as dialysis machines and other bioartificial supports physically limit patient activity, require adherence to strict dietary and medication regimens, and have high clinical costs.Artificial support systems utilize devices that can remove toxins by absorption or filtration.

Artificial heart

Scientists and clinicians can use 3D printing for cardiac surgical planning and creating custom-fit implants. The device takes over for your damaged heart, pumping blood through the body and maintaining healthy circulation.



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III. DRUG DELIVERY

This topic has been of particular interest to pharmaceutical scientists. Biodegradable or biological materials are now being extensively investigated by researchers in drug delivery systems in the form of microcapsules and nanocapsules. Different materials have been used. use of lipids is a common approach. This includes the use of lipid–protein membranes [6], concentric lipid membranes and submicron ultrathin lipid membranes .

IV. PHARMACEUTICAL APPLICATION

The company has successfully printed patches of tissues of the liver, lung, heart and kidneys for use by research partners. The company's ExVive line of human liver and kidney tissues are used in toxicology studies and other preclinical drug testing. This application of artificial organs has tremendous potential to accelerate the drug development process, lower costs, and reduce the need for animal and clinical testing. In fact, L'Oreal, the global cosmetics company, sources 3-D-printed human skin tissues from Organovo with the aim of reducing much-reviled animal tests. L'Oreal already owns a patent on Episkin, a tissue-engineered skin product that has been developed by incubating skin cells donated by surgery patients. The partnership with Organovo would enable L'Oreal to print them more easily, and to requirements.

The delay in producing a fully functional, dimension-matched organ will disappoint the organ transplant market, it is still news worth cheering. In fact, the entire pharmaceutical industry waits with bated breath for tissues that resemble actual human tissues. Such analogues are of great importance for drug testing.

They do not replicate tissue–tissue interfaces, vascular perfusion, interstitial flow, circulating immune cells or organ-specific mechanical cues that are critical for accurate mimicry of the delivery and absorption, distribution, metabolism and excretion (ADME) of pharmaceutical compounds or their pharmacokinetics and pharmacodynamics (PK/PD). Thus, static microphysiological systems are not optimal for accurate assessment of drug disposition, efficacy and toxicity within the human body. By contrast, microfluidic organ chips can provide all these functions.

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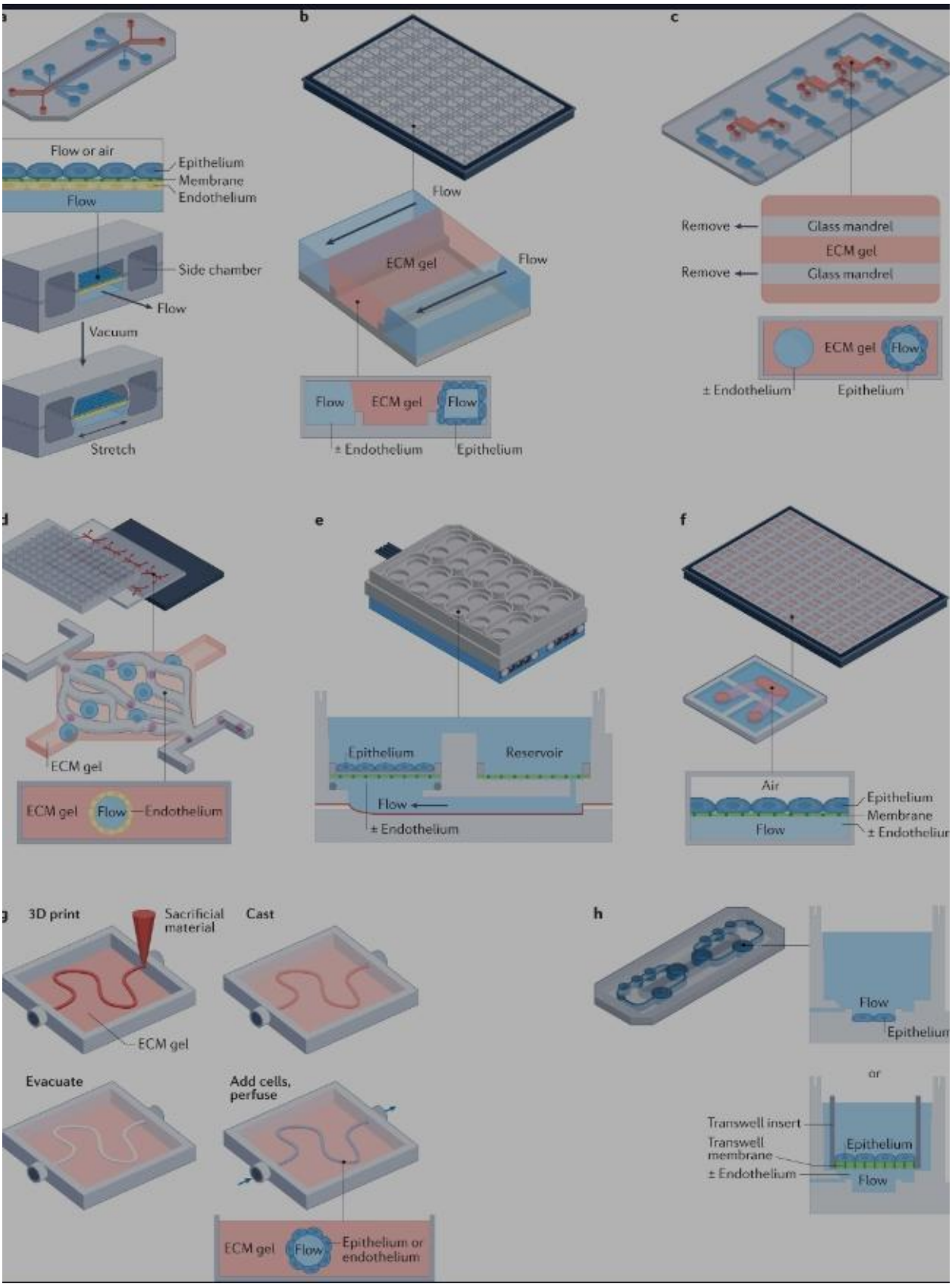

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Organ chip design developed at about the same time used a more conventional, plastic, transwell-like, multiwell (12-well) format in which tissue–tissue interfaces are recreated by culturing two different human cell types (for example, hepatocytes and liver sinusoidal endothelial cells) on opposite sides of a rigid porous membrane within minibioreactor chambers20 (Fig. 1e). A streamlined plastic 384-well format organ chip design also was described recently and used to create an air–liquid interface21 (Fig. 1f). 3D printing technology has been adapted to create dynamically perfused tubular structures lined by human organ-specific cells that can be positioned precisely within printed ECM gels to recreate.

V. CONCLUSION

The company's ExVive line of human liver and kidney tissues are used in toxicology studies and other preclinical drug testing. According to the World Health Organization (WHO) Global Observatory on Donation and Transplantation, there are over 130,000 solid organ transplantations performed annually worldwide. However, it is estimated that this number covers only about 10% of actual needs. Bioprinting technology allows constructing live and functional 3D constructs, which may be a replacement for imperfect animal models used in cosmetics and pharmaceutical industries.

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