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Review on Organ-On-Chip

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ABSTRACT

Recent years have seen a significant increase in interest in organ-on-a-chip (OOC), also known as micro physiological system or "tissue chips". because to the wide range of uses they have particularly in precision medicine, drug development and Screening. Replicating important element of human physiology can, shed light on the function of the understudied organ and the pathophysiology of disease. Additionally, these can be precisely applied in the drug discovery process for personalized therapy OOC design technology has made significant strides in recent years, opening the door to a wide range of biomedical application.

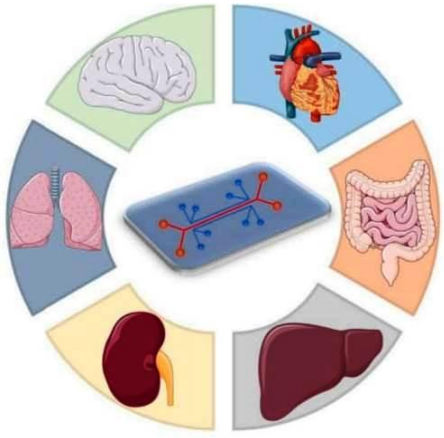
1 Introduction

organ-on-a-chip technologies are being developed to asses medications and therapies without using live animals. These technologies.can stimulate complex organ function for viewing and imaging reason, the majority of the material used to make organ-on-chip-devices must be optically clear, albeit whether they are stiff or flexible depends on the usage of the device. In order to avoid negatively affecting the system. The material must also have the necessary chemistry & reactivity microfluidic devices have been made using glass and silicone. polydimethylsiloxane is a soft synthetic polymer that. is frequently employed (PDMS). PMMA and poly carbonate are two other synthetic polymers used in construction of organ on-chip system.

Researches from all around the world have become interested in this idea since 2011, when the us president declared the commencement of a project on "person on chip"induced pluripotent stem cell (iPSC) technology, which was established in 2006, has since gained popularity as a reliable of human cells for severalorgans, including the kidney, spinal cord, brain and heart

Validating the use of novel treatment involves several stages of preclinical and clinical testing. Each of the four steps of the drug development process. Discover preclinical research, clinical trials and for review can go away, resulting in a large financial loss for the pharmaceutical corporation. The simulation of an isolated.organ may miss important biological phenomena that occur in the body's intricate web of physiological processes, and this oversimplification. This is drawback of the early organ-on-chip approach. several ports of later microphysiometry strive to overcomethis limitation by simulating more complex, physiological responses. via microfabrication microelectronic and microfluidics.

microfluidics has advanced to thepoint where it can assess the efficiency of Pharmaceutical in a lab-on-chip field. OOC is used in pharmaceutical industry to identify and detect various drug compound. in both amount and quality. There are new additional application available for pharmaceutical analysis, including those for medication quality control, drug screening and medicine.



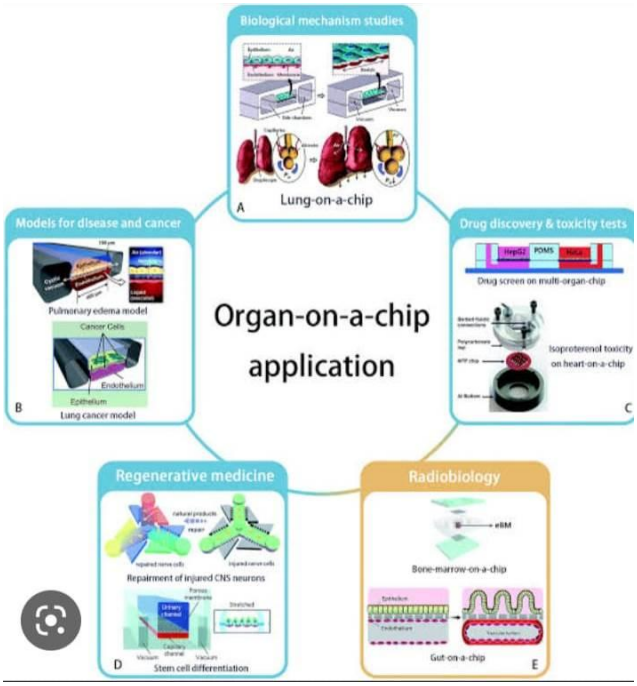
The later part of the paper we have discussed about different advantages and disadvantages. Further part we have studied what is lab-on-chip? also studied different organ on which chips is developed. The last point is conclusion about organ-on-chip.

2.Advantages of Organ-On-Chip

- Save time, money.
- used in both quality & quantity. detection of drug.
- Save space.
- OOC used in pharmaceutical field.
- P E T A C People for ethical treatment of Animal] important in tumor research.
- At same time many drug and dose.
- A convincingly modelled microenvironment.

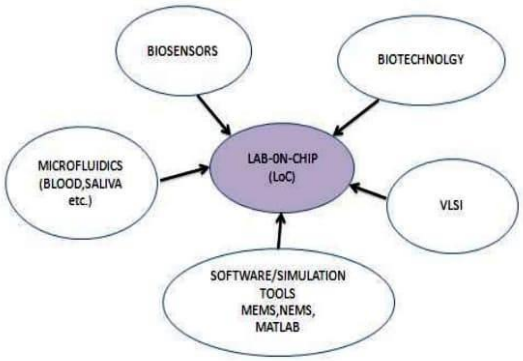
3.Disadvantages of organ-on-chip.

- Not practicable.
- one of the disadvantage is laminar flow has minimal mixing
- They show surface effect.
- Some experiment required special instrument.



4.Lab on-chip

Lab- on-chip devices combine one or more laboratory operation on a single integrated circuit, often known as a "chip". It is only a few square centimeters in size. LOC are capable of handling fluid quantities as small as picolitres. Microelectromechanical system (MEMS) device which include known as lab on-chip technologies are sometimes known“micro total analysis system" (TAS). Microfluidics, the physics manipulation and study of minuscule volume of fluids may be. used by LOC’s.

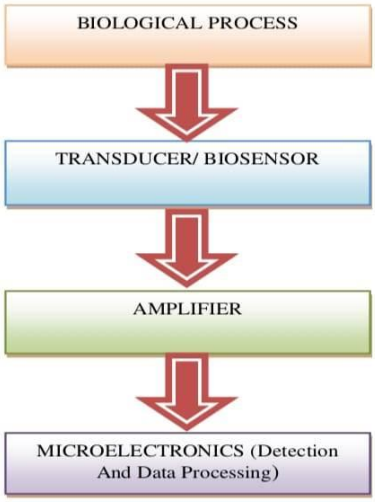


Mutidisciplinary field of LOC

The integration of fludics, electronic, optics and biosensors is the essence of LOC. The primary driving force behind LOC is the requirement for cutting edge pathological analysis. The Strategies for the early stage diagnosis of fatal and chronic disease can be discovered using LOC’s. Modern technology like MEMS and NEMs as well as the widespread integration of these technologies have made it possible to on a

single chip.

The lab-on-chip process firstly collecting sample then this sample give extracted analyte part. Then sample transfer in transducer show optically mechanically action After the transducer sample goes for amplification. In the amplification counting and Sorting is done. finally goes in last step that is microelectronic.



Representation lab-on-chip process diagram

Advantages

- few wastage
- Lowcost
- Analysis response is fast
- LOC used in diagnostic HIV infection.
- Used in diagnostic of disease
- Loc used for immunoassay
- Used in detection of gene chip, DNA chip

Disadvantages

- Expensive equipment.
- Required expert person.
- They more complex than conventional lab

Lab-On-a-Chip market by Region

- North America
- Europe
- Asia pacific
- Latin America
- Middle fast
- Africa

6. Mechanism of microfluid bioengineering and its application

A series of tiny channels that have been etched or molded into a substance is called a microfluidicchip (Glass, Silicon or polymer such as PDMS for poly Dimethyl siloxane). To obtain the necessary features the micro-channels composing the microfluidic chip are interconnected (mix,pump ,sort, control the biochemical environment).

A few millimeters to several micron are the size range of microchannels found in microfluid devices. The Thickness of a human hair is around 100 microns. In the biological sciences, microfluids has gained popularity because it makes it possible to conduct precise, controlled testing morequickly and economically.Lab-on-a-chipdevices make use of microfluidics for things like Organ-on-Chip research or point of care disease diagnostics.

Using external active system (pressure controller syringe pump or peristaltic pump) passive method (tubing, syringe) adapter , simple holes in the chip or both (liquid or gaseous) are injected into and withdrawn from microfluidic chip through holes. (hydro-static pressure).

microfluidics is used for a verity of purposes. A tiny size scale in the micronrange should be used first. Every 30 from type such as a rectangular channel or chamber has a surface area to volume ratio that rises with decreasing size. The capture of object likes cells, pathogens or nanoparticles via microchannels is therefore advantageous asa result lab on-chip devices are created using microfluidics to combine or traditional laboratory procedure in order to save money or speed up the process

Application of microfluid

- Microchannel are used in cell biology studies
- microfluidic devices to create a variety ofcrystallization condition (temperature pH,humidity)
- useful for protein crystallization.

- Most experimental fields of science andengineering
- Manufacture of chemicals, fertility testing. diagnostics.

7. Analyzed organ:

organs are made up of many cell types. Depending on their function within the body. The structure of the organ's cells varies based on the kind of cell, since various organ provide different functions. The organ of human body one following:

1. Liver
2. Breast
3. Pancreas
4. Lungs
5. Brain
6. Blood
7. Heart
8. gut wall

Organ	Features
1. Pancreas	Studies on diabetes and cancer due to minimal number of vessels difficult to cure.
2. Lungs	Poor regeneration abilities.
3. Liver	Maintain its physiological characteristics, great regenerative properties.
4. Brain	Complex due to functionality, can be recreated by separating the soma and axons.
5. Blood	OOc uses al cell types, small chambers.

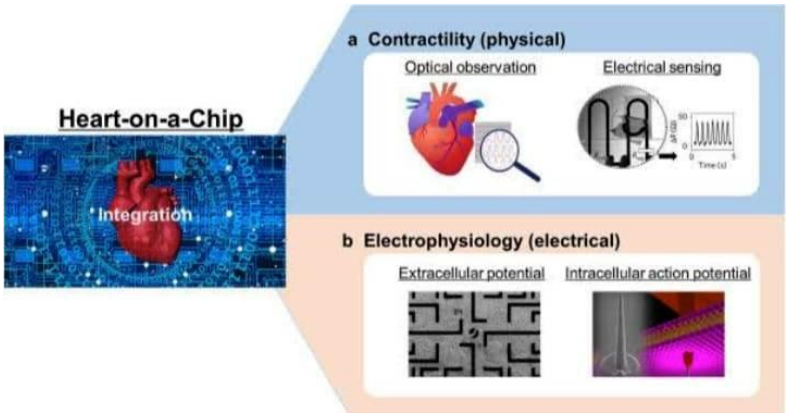
Out of that we will study about heart-on-Chip and Lungs-on-Chip in short way.

Heart on-chip

According to WHO, Cardiovascular diseasesare leading causes of death. According to estimates cardiovascular disorders caused 17.3 million deaths in 2008. Thus almost 30% of fatalities in 2008 were attributable to heart Failure. Inaddition, one of the main reason people experience medication withdrawal is cardiotoxicity.

The heart is one of the most vital organ in human body. It powers blood circulation, which delivers oxygen & nutrients to organ while also removing metabolicdevices waste.Heart disease has become the leading cause of death, It is necessary to establish disease model in order to study, the pathogenesis of heart diseases and pursue effective treatment. two most common method are animal models & cell culture.

Heart-on-chip , the purpose of a heart on a chip is to cultivate cells in highly regulated microfluidic environment in which heart calls naturally exist. The heart-on-a-chip devices are made up of several micro chambers and microchannel imprinted on a layer of polymer which is then bonded to another substance because to its desirable qualities including as transparency and biocompatibility. polydimethylsiloxane is frequently employed on the polymeric material to manufacturethese microfluidic devices.



Application

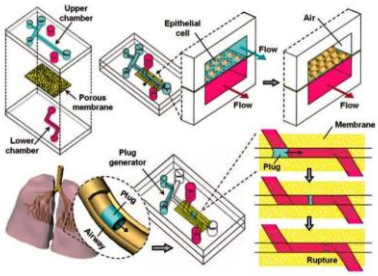
According to research, heart-on- -chip technology has the potential for pharmacologic andresearch application. particularly when using in targeted system. For Contraction and action potential.The first microchip devices described can apply & transversal force with its cantilever and directly measure the FCTC response. They remain for the duration of cell culture as well as the measurement taken during analysis phase.

When compared to traditional measurement devices, this measurement technique is simple more accurate and less expensive. Having a dependable heart-on-chip paves the way for a human-on-chip. It is critical for day testing to asses not only cardiotoxicity but also global inter organ inter reaction

lung on-chip

On a microchip there is a sophisticated three dimensional representation of a functioning ,breathing human lung. The device which mimics the inflammatory response.brought on microbial pathogen was created using human blood vessel and lung cells. It can forecast how well airborne nanoparticle will be absorbed. It can be used to examine the impact of environmental contaminants, the effectiveness of novel medications and the absorption of aerosolized treatment. Animal testing is anticipated to replace by it.

The first introduced by Huh et al. in 2007, was in fact a prototype for the device described above but it merits discussion because it applied microfluidic engineering to produce a different result.The apparatus from Hub et al.showed the same kind of cell line membrane separated chamber, one of which was the “alveolar”, air filled chamber and other was the “vascular”, cell media filled Chamber. Even though there was no cyclic stretching of the membrane in this model. A physiological occurrence that can happen with the spread of pathogenic mucus plugs in condition like copp, asthma pulmonary edoema and bronchiolitis. utilizing these liquid plugs.



8.Conclusion

We looked at are cent -chip technology advancement. The development of organ-on-a-chip is well supported by microfluidic chips. Many Organ-on-a-chip have been created and developed. Many different human organ have been investigated. Is on important field that, with further development can lead to new and revolutionary discoveries.one of them is the human body-on-chip. In most cases, the medicine used to cure a specific type ofdisease may aid in the recovery of a specific organ, but there may be side effects in other organ. Having model of the human body made up of a network of OOC connected Could put an end to animal testing and accelerate the pharmaceutical field.
Most importantly as the number of organs-on-chip rises functioning gets organs on more complicated and hazards associated with generated data. The Indicators identified in vitro may not completely reflect theequivalent in the event of long term repeatedadministration organ-on-chip research.

Reference

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