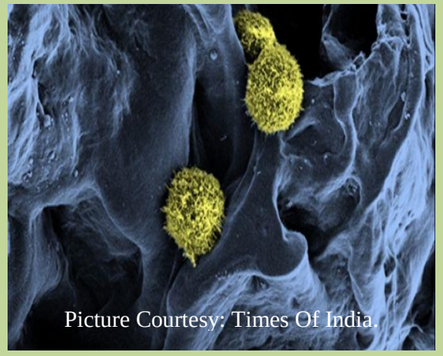
lingering thoughts...

" The first century of the new Millennium will belong ... also to biotechnology which will bring unprecedented advances in human and animal health, agriculture and food production, manufacturing and sustainable environmental management "

-Ben Ngubane-



Picture Courtesy: Times Of India.

Skin Grafts Keep Getting Better and Better

-Anju AV (716)

Blood and lymphatic capillaries grown for the first time in the lab!

Till now complex skin grafts never contain any blood or lymphatic capillaries, pigmentation, sebaceous glands, hair follicles or nerves. But this month, researchers at the Tissue Biology Research Unit, the research department of the Surgical Clinic and at the Research Centre for Children at the University Children's Hospital Zurich have succeeded in engineering a more complex organ.

They were able to isolate all the necessary skin cells from a human skin sample and to engineer a skin graft similar to full-thickness skin that contains for the first time, blood and lymphatic capillaries too. This is extremely good news for around 11 million people who suffer from severe burns across the globe!! The researchers isolated lymphatic capillary cells from the human dermal layer. Together with the blood capillaries (also engineered), this guarantees rapid, efficient vesicular supply of the skin graft. Up to now, this had been a major unsolved problem in molecular tissue biology and regenerative medicine. Hopefully, one day it's going to be affordable too.

Leukemia's possible rival!

-Ayisha (718)

German scientists have developed artificial bone marrow that allows stem cells to multiply and may simplify the treatment of leukemia in a few years.

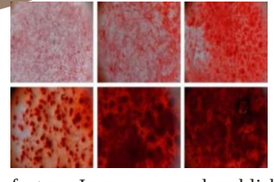
The synthetic porous structure possesses essential properties of natural bone marrow and can be used for the reproduction of stem cells at the laboratory. So far it has been impossible to grow Hematopoietic Stem Cells out of the bone marrow, as these cells retain their stem cell properties in their natural environment only.

With the help of synthetic polymers i.e. biomimetic macroporous PEG hydrogels as 3D scaffolds multiplication of human hematopoietic stem (from cord blood) and progenitor cells was made possible. Scientists created a porous structure simulating the sponge-like structure of the trabecular bone (the material within bone where bone marrow is held) in the area of the blood-forming bone marrow. They added protein building blocks similar to those existing in the matrix of the bone marrow for the cells to anchor. Other cells like mesenchymal stem cells were added to give the HSCs a 'homely feel'.(pic; stem cells in scaffold).

Compared to standard cell cultivation methods, more stem cells retain their specific properties in the artificial bone marrow. The greatest challenges in producing HSCs in the lab have been their limited longevity outside of the bone marrow environment. This problem may soon be overcome with the creation of this artificial bone.

Using clay to grow bone

-Shilpa (740)



It looks like synthetic silicate nanoplatelets (also known as layered clay) can induce stem cells to become bone cells without the need of additional bone-inducing factors. In new research published online May 13, 2013 in *Advanced Materials*, researchers from Brigham and Women's Hospital (BWH) are the first to report that synthetic silicate nanoplatelets (also known as layered clay) can induce stem cells to become bone cells without the need of additional bone-inducing factors. Synthetic silicates are made up of simple or complex salts of silicic acids, and have been used extensively for various commercial and industrial applications, such as food additives, glass and ceramic filler materials, and anti-caking agents.

They believe that these highly bioactive nanoplatelets may be utilized to develop devices such as injectable tissue repair matrixes, bioactive fillers, or therapeutic agents for stimulating specific cellular responses in bone-related tissue engineering,

Picture courtesy: *Khademhosseini lab.*

In this issue >>>

RECENT DEVELOPMENTS IN TISSUE ENGINEERING

BioQue

EDITORIAL

The field of Biomedical engineering is quite vast. It draws upon the knowledge from a wide spectrum of scientific and engineering disciplines. Tissue engineering is one specific area of Biomedical engineering, where a Bioprocess engineer could make some notable contributions. The concept of Tissue engineering was articulated by Y.C. Fung (1985). Later, Prof. Robert Langer of Massachusetts Institute of Technology and Dr. Joseph Vacanti of Massacchusetts General Hospital, worked collaboratively and enriched this venerable discipline with a plethora of alluring applications of immense benefit to mankind. In developed nations, huge fiscal investments are pouring into research on tissue engineered organs, which could partly or fully substitute conventional whole- organ transplants. Even start-up companies are enthusiastic about manufacturing and marketing tissue engineered medical products. Tissue engineering research in India is presently at its budding stage. Considering its enormous scope, a handful of academic and research institutes in India which are fairly specialized in Bioengineering, are turning their research focus towards Tissue engineering. As a Bioprocess engineer, one could at any time think "*out of the box*" and set the goal towards pursuing a promising career in this novel field. The current newsletter aims to provide a bird's eye view of the most recent developments in this field, which is sure to be of substantial academic interest to beginners.

Biju Jacob
Assistant Professor
BT & BCE
SCTCE

The future is here!!!

- Aravind SP (704)

3D printed face masks, bone fragments, living tissues and even human livers, now more human body parts have been 3D printed or grown in labs! We bio-engineers are on a roll!!

In, China, scientists have successfully 3D printed human kidneys! The miniature sized kidneys are made up of 90% living cells and can last up to 4 months in a lab. They are made of a water rich material called hydrogels. The process for printing these kidneys is different from traditional 3D printing. Because they contain living cells they need to account for enough space for the cells to grow. The mini kidneys are fully functional, able to metabolize, secrete fluid and even breakdown toxins.

The mini kidneys are fully functional, able to metabolize, secrete fluid and even breakdown toxins.

The same research teams also 3D printed replacement human ears using the same process. Both the ears and kidneys were produced using the Regenovo 3D bio-printers, developed in China last August.

Tissue engineered miniature kidney

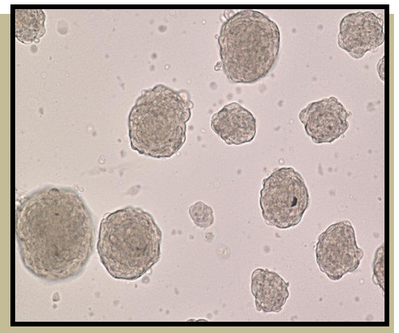
In US, the researchers at Princeton University are working on their own 3D printed ears. Researchers are printing their own bionic ears by combining electronics with bio-tissue. takes about 4 hours to print. The printer alternates between 3 different layers of materials- A mix of bovine cartilage forming cells suspended in hydrogel, one suspension of silver nanoparticles to conduct electricity and silicone to encase the electronics. The bionic ear is c capable of detecting frequencies a million times higher than the normal range of hearing. Right now the ear appears to be a proof of concept.

Pictures courtesy:Science Daily/2013

Human Stems Cells-Sans-Controversy! Finally!

-Abhilash (742)

Haruko Obokata (below), a young post-doctoral researcher now at the Riken Centre for Developmental Biology in Kobe, Japan, startled the world last month when she explained how she created Embryonic Stem Cells from the blood of mice by simply bathing the murine blood cells in a weak solution of citric acid for half an hour (bottom). The researchers called these new totipotent cells stimulus-triggered acquisition of pluripotency (STAP) cells.



> ...the conversion of mature cells back to stem cell stage was the body's natural repair mechanism in the event of some kind of stress.

Dr Obokata began the research in 2008 in the United States after being recruited to work in the laboratory of Charles Vacanti (a tissue engineer at Brigham and Women's Hospital in Boston, Massachusetts). He believed that the conversion of mature cells back to stem cell stage was the body's natural repair mechanism in the event of some kind of stress.

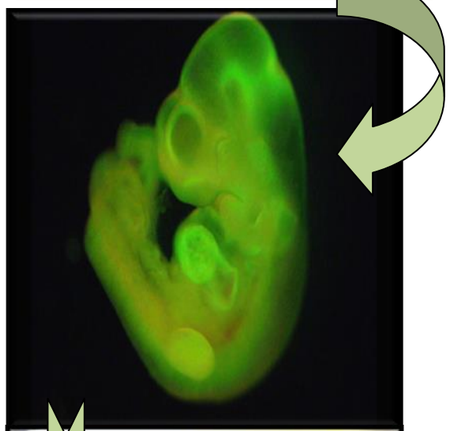
Talk about speedy work, during the first week of February, it appears that the same thing may have been done using human cells! The picture (right) above is said to be images of the first human "STAP cell" experiments. If they can do this in human cells, it changes everything.

The technique promises cheaper, quicker and potentially more flexible cells for regenerative medicine, cancer therapy and cloning.

Vacanti and his colleagues say they have taken human dermal fibroblast cells, which came from a commercial source of human tissues sold for research purposes, and tested several environmental stressors on them in an attempt to recreate human STAP cells.

He won't reveal what type of stressors was applied but he says the resulting cells appears similar in form to the mouse STAP cells. His team is in the process of testing to see just how stem-cell-like these cells are. But more research needs to be done to see that these are indeed stem cells, though Vacanti is 98% comfortable with the present results. Fingers crossed!

Pictures courtesy: Science Daily/2014



Haruko Obokata

IS AUTOLOGOUS LUNG GRAFT POSSIBLE???

-Shalu Mathew (737)

Columbia University Medical Center (CUMC) researchers have successfully developed functional lung cells from human stem cells. It is significant in modeling lung disease, screening drugs, studying human lung development, and generating lung tissue for transplantation.

Present lung transplants have poor prognosis and are subjected to rejection problems. The development of autologous lung transplants i.e., transplants that use a patient's own skin cells to generate functional lung tissue can overcome these problems to a great extent. The basis of research was the discovery of a set of chemical factors by Dr. Snoeck and his colleagues that can transform human embryonic stem (ES) cells or human induced pluripotent stem (iPS) cells into anterior foregut endoderm—precursors of lung and airway cells. The resultant cells expressed markers of at least six types of lung and airway epithelial cells, particularly markers of type 2 alveolar epithelial cells.

Researchers hope to produce artificial lung transplants in future using this technology. The method would follow taking a lung from a donor; removing all the lung cells, leaving only the lung scaffold; and seeding the scaffold with new lung cells derived from the patient. In this way, rejection problems could be avoided. The picture below shows Stem cells differentiated to type II alveolar lung epithelial cells (green). Transformed cells express surfactant protein B (red) indicating functional type II cells.

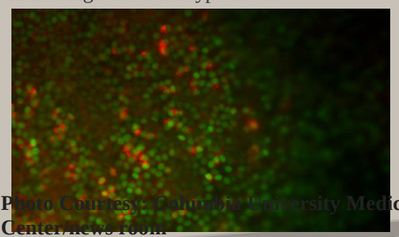


Photo Courtesy: Columbia University Medical Center/News Room

Human on a chip

-Ammu S Parvathy (713)

There was a time when the thought of manufacturing organs in the laboratory was science fiction, but now that science is a reality.

Tissue Engineering has become a new revolution where anything and everything can be modelled. Modelling diseases means, creating tissue that can be used in the lab to model human diseases and test potential new drugs. The response of animal cells towards new drugs may be different from those of human cells. With the advent of tissue engineering it has now become possible to check the compatibility of each and every tissue of our human body to a foreign implant.

The "human on a chip" research focuses on in vitro human organ constructs in communication with each other. This has been developed by the Army Scientists at the Edgewood Chemical Biological Center and academia to check the response of body against chemical warfare agents and to develop treatments for the same.

The goal is to assess effectiveness and toxicity of drugs in a way that is relevant to humans and their ability to process these drugs. Each organ-on-a-chip is about the size of a thumb drive and is an "organoid" designed to mimic the properties of an actual human organ. The organoids created by induced pluripotent stem cells from adult skin cells comprise multiple layers of c ells growing on

> The "human on a chip" research focuses on in vitro human organ constructs in communication with each other.

a membrane,connected to each other by micro fluidics that copy the function of blood vessels. Since human-on-a-chip is made from human cells, it is the next best thing. Human tissue reacts like human tissue.

Heart to Heart

-Anjali Babu (714)

Scientists have finally developed a tissue model for the human heart that can bridge the gap between animal models and human patients.

These models exist for other organs, but for the heart, this has been elusive. Specifically, the researchers generated the tissue from human embryonic stem cells with the resulting muscle having significant similarities to human heart muscle. This research was published in the February 2014 issue of *The FASEB Journal*.Cardiovascular Cell and Tissue Engineering Laboratory, Cardiovascular Research Center at Mt. Sinai in New York developed this thing of beauty! To make this advance, they cultured human engineered cardiac tissue (hECTs), for 7-10 days and they self-assembled into a long thin heart muscle strip that pulled on the end-posts and caused them to bend with each heart beat, effectively exercising the tissue throughout the culture process.

These hECTs displayed spontaneous contractile activity in a rhythmic pattern of 70 beats per minute on average, similar to the human heart. They also responded to electrical stimulation. They found several interesting facts, the heart responses were similar to adult heart, some of the responses were similar to those found in the newborn heart, also, they could be incorporated with genetic information by an adenovirus. The future implications seem boundless!

Hearts Will Go On.....

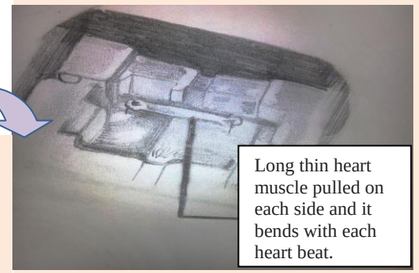
-Hima Shwetha (726)

We all have scars on our hearts. First love, failed marriage, loss of a loved one, the list can be long. More serious scars are ones that come from physical damage, permanent scar tissue from an event like a heart attack. Scarred heart cells do not beat like normal but Bio Engineers at the University of Michigan have found a way to reprogram new cells to repair the damage. Cells harvested from mouse embryos are reprogrammed into stem cells that band together as they grow, similar to healthy heart cells. After a few day they are fed a protein for encouraged growth and eventually beat on their own.

The process still needs some work to get the cells to be accepted but is a great leap in repairing a broken heart!

Today In History…

- *2012: Scientists successfully regenerate silence stenophylla from a 31,800 year old piece of fruit, greatly surpassing the previous record of 2,000 years.*
- *Born-1937 Robert Huber: German biochemist, who along with Deisenhofer and Michel received Nobel prize for chemistry in 1988 for determination of 3D structure of a protein essential for photosynthesis.*



Long thin heart muscle pulled on each side and it bends with each heart beat.