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**DEPARTMENT: PHARMACHOLOGY**

Medical Biotechnology is the use of living cells and cell materials to research and produce pharmaceutical and diagnostic products that help treat and prevent human diseases.

Applications /Aspects of Medical Biotechnology

1. Pharmacology

2. Gene Therapy

3. Stem Cells

4. Tissue Engineering

* PHARMACOLOGY
1. Insulin Production

Production of genetically engineered human insulin was one of the first breakthroughs of biotechnology in the pharmaceutical industry. Insulin was first produced in Escherichia coli through recombinant DNA technology in 1978.

Principle: - Mass production of human proteins, vaccines, etc. by genetically modifying bacteria or viruses.

Process: - The human gene for insulin is placed into bacteria, are cultured and allowed to produce insulin which is collected, purified and sold to diabetics worldwide

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2. Human Growth Hormone

Production of human growth hormone was first done in 1979 using recombinant DNA technology. Scientists produced human growth hormone by inserting DNA coding for human growth hormone into a plasmid that was implanted in Escherichia coli bacteria. This gene that was inserted into the plasmid was created by reverse transcription of the mRNA found in pituitary glands to complementary DNA. Prior to this development, human growth hormone was extracted from the pituitary glands of cadavers, as animal growth hormones have no therapeutic value in humans.

3. Human Blood Clotting Factor

Production of human clotting factors was enhanced through recombinant DNA technology. Human clotting factor ix was the first to be produced through recombinant DNA technology using transgenic Chinese hamster ovary cells in 1986.Plasmids containing the factor IX gene, along with plasmids with a gene that codes for resistance to methotrexate, were inserted into Chinese hamster ovary cells via transfection

* GENE THERAPY

Gene therapy is the use of DNA as a pharmaceutical agent to treat disease. It derives its name from the idea that DNA can be used to supplement or alter genes within an individual's cells as a therapy to treat disease; The most common form of gene therapy involves using DNA that encodes a functional, therapeutic gene to replace a mutated gene. Gene therapy is of two types, somatic gene therapy and germ line gene therapy.

Gene Therapy for Diseases

Gene Therapy has made important medical advances in less than two decades. Within this short time span, it has moved from the conceptual stage to technology development and laboratory research to clinical translational trials for a variety of deadly diseases. The most notable advancements are the following:

1. Chronic Granulomatus Disorder (CGD)

CGD is a genetic disease in the immune system that leads to the patients' inability to fight off bacterial and fungal infections that can be fatal. Using similar technologies as in the ADA-SCID trial, investigators in Germany treated two patients with this disease, whose reconstituted immune systems have since been able to provide them with full protection against microbial infections for at least two years

1. Hemophilia

Patients born with Hemophilia are not able to induce blood clots and suffer from external and internal bleeding that can be life threatening. The therapeutic gene was introduced into the liver of patients, who then acquired the ability to have normal blood clotting time.

* STEM CELLS

A stem cell is a cell that has the potential to become any cell type in the human body. Everyone has stem cells, but they are very hard to access. The easiest place to get stem cells is from an embryo. Stem cells are introduced into a damaged area of the body where, under the right conditions, will replace the damaged area.

Principles: Stem cells are introduced into a damaged area of the body where, under the right conditions, will replace the damaged area.

Application :The main areas where stem cells have proven their worth is in bone marrow transplants, replacing damaged heart tissue after a heart attack and replacing damaged nerve tissue which gives hope to anyone who has had a spinal cord injury.

Process: Often time’s stem cells are grown in a lab first to ensure the right conditions and then placed into a sick person.

STEM CELLS (SOURCES)

 Embryonic stem cells

 Infant and adult stem cells

  Present in small numbers in

 Bone marrow

 Peripheral blood

 Skin epithelium

 Umbilical cord blood

 Dental pulp of infant’s teeth

 May be obtained by reprogramming somatic cells

 Introduction of retroviruses carrying reprogramming genes into fibroblasts

* TISSUE ENGINEERING

A form of regenerative medicine, tissue engineering is the creation of human tissue outside the body for later replacement. Usually occurs on a tissue scaffold, but can be grown on/in other organisms. The technique to grow an ear follows the steps;

 1) Taking a tiny piece of cartilage tissue,

 2) Dissolving away the white springy tissue to collect the actual cells inside (the cells are microscopic and trapped inside the white tissue called matrix)

3) Expanding the number of cells by various methods in the lab

4) Placing that increased volume of cells on or in mould that have a shape of an ear

5) Implanting the new ear onto the patient.

 Tissue engineers have created artificial skin, cartilage and bone marrow. Current projects being undertaken include creating an artificial liver, pancreas and bladder. Again, we are far from replacing a whole organ, but just looking for “refurbishing” our slightly used ones at the moment.