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Popular Article

Cutting Edge Techniques in Veterinary / Medical Science

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Abstract

The aim of recent treatment aims at regeneration rather than repair. Modern Scientists emphasize that treatment modalities should be such, which deals with functional restoration of tissues or organs for the patient suffering from severe injuries or chronic diseases. The spectacular progress in the field of research has laid the foundation of “Cutting edge techniques” for the diseases which cannot be cured by conventional medicines. Stem cell and regenerative medicine is a promising technique which comes into picture when the recent advances are discussed. Amalgamation of regenerative technique and tissue engineering is one of the recent practices that had changed the way of treatment. Use of antibiotics for treatment of human beings and animals in future will be a talk of yesteryear. Future of treatment will solely lie on regenerative techniques, tissue engineering and gene therapy.

Key Words: Cell Therapy, Growth factor, Regenerative medicine, Stem cells, Tissue engineering

Centuries before the discovery of antibiotics, treatment was based merely on different unethical practices and is referred to as “Dark Ages” of medical science. Credit for the discovery of “miracle drug” goes to Sir Alexander Fleming, who discovered penicillin in 1928, the first antibiotic. Sir Alexander Fleming was awarded Nobel Prize on 10th December 1945 for his discovery. Alexander Fleming was a Scottish physician and scientist (Tan and Tatsumara, 2015). Antibiotics turned out to be a milestone for the modern treatment regimen. Century succeeding discovery of antibiotics, treatment aimed at “life for life”. Basic principle of treatment of disease after discovery of antibiotics is to take a drug, it will kill the target organism and cure the disease. Life for life is a simple approach and it is so fascinating that other disease which is not due to an organism is too treated in the same manner. Our body consist of millions of chemical reactions. The available chemicals or pharmacopoeia taken together till date is approximately about 200 – 300. Hence treatment of millions of diseases in the body system almost becomes impossible. It is just like seeing a part of galaxy by means of a telescope and believing that the whole universe is visible. In recent years, the focus of medical/ veterinary science has shifted from repair to regeneration. Thus, the cutting-edge technique “The Regenerative Medicine” comes into the practice. These techniques aim to recover the normal

function of diseased or damaged cells, tissues, and organs just as the nature heals itself. Here the aims and objective are to just enhance the body's innate repair system.

Recent Techniques

- (a) Biological implants/Scaffolds (b) Growth factors (c) Cell therapy (d) Tissue engineering
- (e) Gene therapy

a) **Biological implants / Scaffolds**

Scaffolds are the tissues that are moved from one place to other, where it is in deficit. In day-to-day treatment procedure, the clinician often goes through various patients where there is extensive loss of tissue. Extensive loss of any tissues delays healing or predisposes to non-healing. Therefore, it necessitates the surgeon to transfer scaffold from the host or some other animal.

Classification Of Biological Implants / Scaffolds

- (i) Auto graft
- (ii) Allograft
- (iii) Xenograft

Autograft- Autograft is tissue moved from one location within the body to another. Autograft is considered as the gold standard of graft but it is having some limitations and one of the prominent limitations is its scarce availability. If the tissue requirement at an area is small, it can be collected from the same individual and if it is large, it should be collected from other individual. For collection of skin, the place of choice in the same individual will be area where there is loose skin, such as near the wither, abdomen etc. For collection of bone, iliac crest is the best site.

Allograft - Allograft is when tissue is donated from one person to use for tissue reconstruction and repair in another person of the same species. The tissue can be collected from the cadaver or living individual of the same species. The best part of this process is that the tissue can be collected in plenty and can be used sufficiently at the place of requirement.

Xenograft- Xenograft is the transplantation of living cells, tissue or organ from one species to another. Now a days, skin from the fish tilapia is used for transplantation in excessive tissue loss. When the tissues are being used from one breed or species to transplant it in other breed or species, decellularization protocol is necessary or else it elicit a tissue or organ rejection process.

Decellularization

Decellularization is the process of leaching out the intracellular content of cell. It can be achieved by physical, chemical, biological / enzymatic methods or a combination of these approaches, which rely on a common basic principle of cell membrane disruption and escape of intracellular cellular contents.

Physical Methods of Decellularization-

Physical method includes scrapping, solution agitation, sonification, pressure gradient, snap-freezing, non-thermal irreversible electroporation and use of supercritical fluids.



Chemical Methods of Decellularization-

Chemical methods include use of acids and bases, hypotonic or hypertonic solutions, detergents, alcohol and other solvents.

Enzymatic Methods of Decellularization

Nuclease, trypsin, collagenase, lipase, dispases and thrombolysin. These enzymes can provide high specificity for the removal of cell residues of undesirable ECM.

Chelating Agents of Decellularization-

Non-ionic detergent and rapid freeze and thaw technique lead to efficient reduction of all cellular and nuclear material with no adverse effect on composition, biological activity and mechanical integrity of remaining extra cellular matrix.

b) Growth Factors

Platelet Rich Plasma (PRP)

Platelet rich plasma is an autologous (self-derived) conditioned plasma that contains a high concentration of platelets. It contains various growth factors like Transforming Growth Factor β (TGF- β), Platelet Derived Growth Factor (PDGF), Insulin-like Growth Factor (IGF-1), Vascular Endothelial Growth Factor (VEGF), Epidermal Growth Factor (EGF) and Fibroblast Growth Factor (FGF). These are responsible for angiogenesis, mitogenesis, Macrophage activation, cell growth, proliferation and differentiation. Many of the cytokines found in PRP are involved in the signaling pathways that occur during healing stages of inflammation, cellular proliferation, and subsequent tissue remodeling (Boswell *et al.*, 2012).

Platelet Rich Fibrin (Prf)

PRF is an immune and platelet concentrate collecting on a single fibrin membrane, containing all the constituents of a blood sample which are favorable to healing and immunity (Mosesson, 2001). It can be prepared from centrifugation of blood without anticoagulant. It contains all the growth factor as platelet rich plasma and is too having a fibrin scaffold which provides a platform for cell migration and early healing.

Both PRP and PRF can be used for Tendon and ligament injury. Arthritis, corneal ulcer, Large and ulcerated wounds, Fracture, Damaged cartilage and Nerve injury

C. Cell therapy

Therapeutic application of stem cell-based technologies in Veterinary medicine can be done (Herthel, 2002). Herthel for the first time in history injected large volume (20-60 ml) of naïve bone marrow aspirate obtained from the sternum into an injured ligament. Stem cells” are the ‘naive cells’ or the ‘progenitor cells’ which have the potency to replicate itself or get transformed into a specialized cell as per the requirement of the body, if congenial environment is provided (Kumar *et al.*, 2021). Stem cells differentiate into the surrounding tissue types, which can include bone, cartilage, tendon, ligament, muscle, and nervous tissue. Activate surrounding resident stem cells. Stem cell can be used in number of ailment and is a boon for the clinician in the modern era.



D. Tissue engineering

3 D printers are available now a days, which can construct the organ on the basis of CT scan or MRI. It lays down each layer of the tissue or organ and construct it in a similar fashion as the normal organ or tissue of an individual. It can directly be transplanted or amalgamated with stem cells for enhanced healing.

E. Gene Therapy

Gene therapy is an experimental technique that uses genes to treat or prevent disease. In the future, this technique may allow doctors to treat a disorder by inserting a gene into a patient's cells instead of using drugs or surgery.

Conclusions

Recent techniques in Veterinary/ Medical field is still in its infancy and requires a lot of research. Last decade has shown encouraging and promising research in regenerative medicine and its therapeutic application in livestock and companion animals. Cellular therapy, Organ transplant and Gene therapy will be the keynote player of treatment in Veterinary and Medical science in the coming century.

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