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An Overview of Regenerative Medicines

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Description

The loss of organs and tissues due to disease and damage motivates the development of drugs that can regenerate tissues and lessen the need for transplantation. Regenerative medicine is an interdisciplinary field that employs engineering and life science ideas to promote tissue and organ regeneration. Since the field's foundation decades ago, the Food and Drug Administration (FDA) has approved and commercialised a variety of regenerative medicine therapies, including those for wound healing and orthopaedics. This review will go through these medicines as well as additional regenerative medicine techniques that are currently being researched in preclinical and clinical settings. The latest advances in producing sophisticated grafts and tissue mimics, as well as technology for graft integration with host vasculature, will be addressed. It will be discussed how to improve the host's innate regeneration capability by altering its environment, whether by cell injections or immune regulation, as well as techniques for utilising recently identified cell sources. Finally, we suggest potential directions for regenerative medicine therapy [1].

Regenerative medicine can fix or replace tissues and organs that have been damaged by age, disease, or trauma, as well as rectify congenital abnormalities. Preclinical and clinical studies suggest that regenerative medicine could be used to treat both chronic diseases and acute insults, as well as ailments impacting a wide range of organ systems and contexts, including as cutaneous wounds, cardiovascular disorders and traumas, cancer treatments, and more. The current approach of transplanting intact organs and tissues to heal organ and tissue failures and loss is impeded by a lack of donors and frequently major immunological concerns; however these challenges could be addressed with regenerative medicine technologies [2].

The topic of regenerative medicine comprises a variety of treatments, including the use of materials and de novo produced cells, as well as various combinations thereof, to efficiently replace missing tissue, both architecturally and functionally, or to aid tissue recovery. Although adult humans have limited regenerative potential compared to lesser vertebrates, the body's intrinsic healing response can be used to boost regeneration. The first part of this study will focus on regenerative medicine therapies that have already been approved by the FDA. The preclinical and early clinical studies to alter the patient's physiological environment by introducing materials, living cells, or growth factors to replace damaged tissue or enhance the body's intrinsic healing and repair systems will be discussed next. It will also be explored how to improve the structural sophistication of implantable grafts and how to efficiently use freshly developed cell sources. Finally, future research directions in the field will be suggested. We have grouped these activities under the topic of regenerative medicine in this study due to the significant overlap in how researchers use the phrases regenerative medicine and tissue engineering [3].

A number of therapies have gotten FDA clearance or approval and are commercially available since tissue engineering and regenerative medicine began as a business roughly two decades ago. To date, one of the most important paradigms of regenerative medicine has been the introduction of therapeutic cells that directly contribute to the development and function of new tissues. These therapies involve either autologous or allogeneic cells that are typically differentiated but still have proliferative ability. Carticel, for example, is the first FDA-approved biologic product in the orthopaedic profession, and it treats focal articular cartilage abnormalities with autologous chondrocytes. Autologous chondrocytes are collected from articular cartilage, expanded ex vivo, and transplanted at the injury site, yielding results comparable to those shown with microfracture and mosaicplasty procedures [4].

Other examples include laViv, which uses autologous fibroblasts to improve the appearance of nasolabial fold wrinkles; Celution, a medical device that extracts cells from adipose tissue derived from liposuction; Epicel, autologous keratinocytes for severe burn wounds; and cord blood harvesting for hematopoietic progenitor and stem cells. Autologous cells entail the harvesting of a patient's tissue, which often necessitates the creation of a new wound site, and their use frequently necessitates a delay in treatment while the cells are cultured. Allogeneic cell sources with low antigenicity for example, human foreskin fibroblasts utilised in the construction of wound-healing grafts (GINTUIT, Apligraf) enable bulk production of off-the-shelf tissues while reducing the possibility of an immune reaction [3].

Because materials can replicate the original Extracellular Matrix (ECM) of tissues and control cell behaviour, contribute to the form and function of new tissue, and locally present growth factors, materials are typically a key component of contemporary regenerative medicine techniques. 3D polymer scaffolds, for example, are utilised to encourage chondrocyte expansion in cartilage repair [e.g., matrix-induced autologous chondrocyte implantation (MACI)] and as a scaffold for fibroblasts in the treatment of venous ulcers (Dermagraft) Decellularized donor tissues are also used as tissue substitutes (CryoLife and Toronto's heart valve substitutes and cardiac patches) or to promote wound healing (Dermapure, a variety of proprietary bone allografts) or to promote wound healing (Dermapure, a variety of proprietary bone allografts). As in the case of bioglass-based grafts that allow fusion with bone, a material alone can occasionally give cues for regeneration and graft or implant integration [5].

Conflict of Interest

None.

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