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Translational Medicine and Biomaterial-Based Bone Tissue Engineering

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Introduction

The design of materials that support tissue repair and regeneration faces a significant obstacle in the form of biomaterial-mediated inflammation and fibrosis. Regardless of the numerous biomaterial advancements that have been intended to avoid or stifle aggravation (for example conveyance of mitigating drugs, hydrophobic coatings and so forth.) A foreign body response still occurs in many materials, resulting in the encapsulation of a dense, scar-like extracellular matrix. Biomaterial-mediated fibrosis is primarily mediated by fibroblasts and macrophages, which control inflammation and primarily form new extracellular matrix. Although fibroblasts and macrophages are thought to be the driving forces behind biomaterial-mediated fibrosis, the signaling pathways and spatiotemporal crosstalk that exist between these cell types are still unclear. We set out to figure out how M1 and M2 macrophages and soluble cues contribute to the in vivo fibrous encapsulation of biomaterials in this review [1]. In addition, we focused this review on in vitro models of the foreign body response and fibroblast and macrophage crosstalk. Ultimately, we feature a few procedures that have been utilized to explicitly tweak macrophages and fibroblast conduct in vitro and in vivo to control biomaterial-interceded fibrosis.

Description

While the clinical "gold standard" of bone repair, the autologous bone graft, has limitations such as limited graft supply, secondary injury, chronic pain and infection, bone defects have a global socioeconomic impact. As a result, novel treatments are required to speed up bone healing and reduce the complexity of surgical procedures. The new science of bone tissue engineering (BTE), which was developed in the 21st century and is cross-disciplinary, creates artificial environments that are designed to encourage bone growth and regeneration. BTE creates biological substitutes to restore the functions of damaged bone by combining stem cells, scaffolds and growth factors. Although BTE has accomplished a great deal, there are still problems that need to be solved. In order to provide references for the clinical application of BTE, the most recent research and applications of stem cells, scaffolds and growth factors in BTE are summarized in this review [2].

The interactions between the biomaterials or tissues and the applied probing energy format (such as light, sound, a magnetic field, or an x-ray photon) are the foundation of all biomedical imaging modalities. The probing energy is typically absorbed, scattered and polarized by the objects in these interactions. Resolution, imaging depth and contrast mechanism are just a few of the many criteria that can be used to group imaging technologies together. We chose the contrast mechanism because it is most relevant to the physical, chemical and biological properties of a particular material or tissue type. As a result, it can serve as the most useful guide for choosing the technologies that are best suited for probing biomaterials and biological entities. Acoustic imaging, magnetic imaging, optical imaging, electron imaging, x-ray imaging and nuclear imaging are the most common biomedical imaging modalities because of their contrast mechanisms [3]. From low to high probing energies, we discuss each of the imaging modalities that could be used to characterize interactions between biomaterials and tissues. Notably, an imaging modality's probing energy level is a good indicator of its damage potential: A higher probing energy has a higher potential to cause damage, so it should be used with more caution, especially when working with biomaterials and studying cells that are vulnerable.

Osteoarthritis (OA) is a common chronic disease of the joints that causes pain, stiffness, instability and decreased range of motion and functionality. Numerous new approaches have been proposed, despite the fact that there is currently no effective treatment for OA. Carola Cavallo and others reviewed these new approaches, which included a growth factor/3D printing scaffolding option, gene therapy and stem cell-based therapy. Even though these regenerative techniques still face numerous obstacles when it comes to completely regenerating dysfunctional cartilages, new opportunities are emerging and functional biomaterials are being developed to advance treatment, such as injectable hydrogel that can control joint inflammation [4]. Nathan S. Hwang and others surveyed this perspective capability of aggravation regulating hydrogels for osteoarthritis ligament tissue designing. In addition to OA treatment, immunomodulatory biomaterials are utilized in a variety of other fields. Injectable or adhesive hydrogels containing anti-inflammatory drugs, proteins, genes, or cells have an inherent immunomodulatory function in the management of OA inflammation by regulating the polarization and activity of immune cells. Such immunomodulatory tissue designing arrangements will carry new potential to OA treatment.

Rarely can both biomaterials and biological entities be imaged simultaneously when a single imaging modality is utilized because a given imaging modality is typically only capable of imaging a specific property of the sample. However, the two components can still be distinguished if this property is sufficiently different between the material and the cell; typically, contrast mechanisms are introduced from outside the cell. Acoustic scattering and physical resonance for mechanical imaging, atomic relaxation for magnetic resonance imaging, optical scattering, absorption and fluorescence/luminescence for optical imaging, X-ray attenuation for CT imaging, electron scattering for electron imaging and positron for nuclear imaging are all examples of contrast mechanisms that are highly dependent on the imaging modality [5].

Tantalum is an inert metal that resists corrosion. However, its modulus of elasticity is significantly higher than that of cancellous and cortical bone. As a result, tantalum scaffolds are frequently constructed into porous structures to mimic autologous bone and reduce their elastic modulus. Porous tantalum stents are currently used to treat femoral head necrosis, spinal fusion, foot and ankle surgery and arthroplasty. The results demonstrated the porous tantalum scaffold's excellent biocompatibility and osteoinductivity in BTE because it stimulated the trabecular structure of bone. The porous tantalum scaffold tightly integrated with the host bone in canine femoral shaft bone defect models and new bone formation was observed at the scaffold-host bone interface three and six months after implantation. However, there is some clinical application of tantalum due to the complicated manufacturing process and slow osteogenesis.

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Conclusion

Macrophage and fibroblast behavior in the context of biomaterial-mediated fibrosis, macrophage-fibroblast crosstalk and a variety of biomaterial and drug delivery strategies that modulate macrophage and fibroblast behavior to promote tissue regeneration are highlighted in this review. Last but not least, we offer some perspective on the remaining issues and directions that need to be taken in the area of macrophages and fibroblasts in biomaterial-mediated fibrosis.

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Conflict of Interest

There are no conflicts of interest by author.

References

1. Reilkoff, Ronald A., Richard Bucala and Erica L. Herzog. "Fibrocytes: Emerging effector cells in chronic inflammation." *Nat Rev Immunol* 11 (2011): 427-435.
2. Hinz, B. "The role of myofibroblasts in wound healing." *Curr Res Transl Med* 64 (2016): 171-177.
3. Desmoulière, Alexis, Antoine Geinoz, Franfoise Gabbiani and Giulio Gabbiani, et al. "Transforming growth factor-beta 1 induces alpha-smooth muscle actin expression in granulation tissue myofibroblasts and in quiescent and growing cultured fibroblasts." *Int J Cell Biol* 122 (1993): 103-111.
4. Bocchino, Marialuisa, Savina Agnese, Evelina Fagone and Silvia Svegliati, et al. "Reactive oxygen species are required for maintenance and differentiation of primary lung fibroblasts in idiopathic pulmonary fibrosis." *PLoS One* 5 (2010): e14003.
5. Alili, Lirija, Maren Sack, Katharina Puschmann and Peter Brenneisen. "Fibroblast-to-myofibroblast switch is mediated by NAD (P) H oxidase generated reactive oxygen species." *Biosci Rep* 34 (2014).

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