Bioactive materials and bioprinting: Progress and challenges for applications in tissue engineering

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Abstract

Surface reactive materials, also termed bioactive materials such as bioactive glasses (BGs), represent an important group of biomaterials being highly considered for tissue engineering (TE), including both bone and soft TE. In TE applications biochemical reactions occurring at the interface between the material surface and the biological environment are exploited to provide suitable cellular stimuli for promoting new tissue growth. In the case of inorganic bioreactive materials such surface effects involve the controlled release of biologically active ions as dissolution products to induce specific cellular responses (e.g. osteogenesis, angiogenesis) [1].
Bioactive glasses and their composites in combination with biodegradable polymers will be discussed as an important class of such bioreactive materials having applications in bone tissue regeneration and soft tissue repair. In particular, the release of specific metallic ions from BGs on vascular endothelial growth factor (VEGF) release from stem cells will be shown to demonstrate the angiogenic potential of such biomaterials, a key requirement for developing effective TE scaffolds.
Applications of BGs in the field of 3D bioprinting (biofabrication) have been emerging in the last few years. In the second part of the presentation, the progress in the development and characterization of TE scaffolds made purely from BGs or by combining BGs and biopolymers, including their application in 3D bioprinting will be discussed. Recent results on the development of hydrogel-BG composites as innovative bioinks for cell encapsulation and for 3D bioprinting of cell laden scaffolds will be presented [2], highlighting the properties and applications of bioreactive, multimaterial and colloidal bioinks in the emerging field of biofabrication leading to cell laden 3D structures of increasing complexity and functionality.

References

[1] A. Hoppe, et al., A review of the biological response to ionic dissolution products from bioactive glasses and glass-ceramics, *Biomaterials* 32 (2011) 2757-2774.

[2] S. Heid, A. R. Boccaccini, Advancing bioinks for 3D bioprinting using reactive fillers: A review, *Acta Biomater.* 113 (2020) 1-22.