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Review

Drug-Loaded Biomimetic Ceramics for Tissue Engineering

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Abstract: The mimesis of biological systems has been demonstrated to be an adequate approach to obtain tissue engineering scaffolds able to promote cell attachment, proliferation, and differentiation abilities similar to those of autologous tissues. Bioceramics are commonly used for this purpose due to their similarities to the mineral component of hard tissues as bone. Furthermore, biomimetic scaffolds are frequently loaded with diverse therapeutic molecules to enhance their biological performance, leading to final products with advanced functionalities. In this review, we aim to describe the already developed bioceramic-based biomimetic systems for drug loading and local controlled release. We will discuss the mechanisms used for the inclusion of therapeutic molecules on the designed systems, paying special attention to the identification of critical parameters that modulate drug loading and release kinetics on these scaffolds.

Keywords: bioceramics; biomimetic scaffolds; tissue engineering; bone; local drug delivery

1. Introduction

The aging of the population has led to the need for a new set of engineered biofunctional systems, designed not only to restore the functionality of diseased tissues, but to improve patient's quality of life. Those advanced systems usually present complex design and chemical compositions aiming to regenerate damaged structures by, in most cases, combining biomaterials, cells, and therapeutic molecules. In this context, the tissue engineering field is focused on the development of biological substitutes able to restore, maintain, or improve tissue function or a whole organ [1].

Biomaterials, "implantable materials that perform their function in contact with living tissues", are one of the pillars of the tissue engineering field [2]. They are commonly used to replace and restore the function of damaged tissues, and must fulfill a set of requirements, such as biocompatibility and mechanical stability, to ensure adequate performance [3,4]. There are four main families of biomaterials that can be used as tissue engineering scaffolds, classified based on their chemical composition as metals, ceramics, polymers, and composites (composed by a mixture of two of the above mentioned types).

Metals are generally used as permanent implants for load-bearing applications. This group includes titanium and its alloys, stainless steel, and cobalt–chromium alloys, as the most commonly used examples. The group of ceramics includes a wide variety of materials generally categorized in two groups: bioinert and bioactive. Finally, polymers can be obtained from natural origin or synthetic