Biomaterials with drug release properties – *In vitro/in vivo* design and evaluation

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Abstract

Biomaterials with controlled release of drug can offer interesting advantages over traditional implants by providing additional therapeutic property to the mechanical action. Cyclodextrins, derived from starch, are cage molecules capable of trapping a drug quickly and gradually releasing it into the body. We have developed and patented a method for functionalizing biomaterials with a cyclodextrin polymer. Thus, the medical device obtained can be impregnated in a pharmacological solution just before the surgical intervention according to the patient's pathology.

In the first part, the surface modification of textile medical devices for hernial surgery by cyclodextrin polymer will be presented. Analgesic prolonged-release implants aim to limit postoperative pain. In a second part, in order to increase the reservoir effect, a multilayer system based on cyclodextrin polymer and chitosan was developed on a textile. The objective of this work was to achieve an antibacterial (silver) and analgesic dressing by the release of ibuprofen for the treatment of chronic wounds. Finally, in a final part, an injectable hydrogel based on cyclodextrin polymer and chitosan will be presented. The injectable hydrogel could be loaded with VEGF to promote the vascularization of a bone substitute or by anti-inflammatory drugs to treat osteoarticular pain.

In vascular surgery, vascular prostheses (bypasses) are susceptible to infection. We functionalized the vascular prosthesis with the cyclodextrin polymer that we loaded with one or more antibiotics. Release profiles, in continuous flow simulating in vivo conditions, were determined. The antibacterial activity in vitro (kill time, diffusion test) but also in vivo (model of infected mice) showed the effectiveness of the prosthesis on 9 pathogens. This concept has been extended to other implants such as stents for the treatment of restenosis with paclitaxel release, visceral implants for the treatment of postoperative pain and bone substitutes for the treatment of infections and osteosarcoma. The cyclodextrin polymer has also been declined in combination with chitosan to make multilayer systems for the manufacture of dressings with dual therapeutic activity but also sponges for the treatment of deep bone infections and for tissue engineering.