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ORIGINAL ARTICLE

Effect of Dexamethasone-Loaded Poly(Lactic-Co-Glycolic Acid) Microsphere/Poly(Vinyl Alcohol) Hydrogel Composite Coatings on the Basic Characteristics of Implantable Glucose Sensors

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Abstract

Background:

Hydrogels alone and in combination with microsphere drug delivery systems are being considered as biocompatible coatings for implantable glucose biosensors to prevent/minimize the foreign body response. Previously, our group has demonstrated that continuous release of dexamethasone from poly(lactic-co-glycolic acid) (PLGA) microsphere/poly(vinyl alcohol) (PVA) hydrogel composites can successfully prevent foreign body response at the implantation site. The objective of this study was to investigate the effect of this composite coating on sensor functionality.

Methods:

The PLGA microsphere/PVA hydrogel coatings were prepared and applied to glucose biosensors. The swelling properties of the composite coatings and their diffusivity to glucose were evaluated as a function of microsphere loading. Sensor linearity, response time, and sensitivity were also evaluated as a function of coating composition.

Results:

The PLGA microsphere/PVA hydrogel composite coating did not compromise sensor linearity (sensors were linear up to 30 mM), which is well beyond the physiological glucose range (2 to 22 mM). The sensor response time did increase in the presence of the coating (from 10 to 19 s); however, this response time was still less than the average reported values. Although the sensitivity of the sensors decreased from 73 to 62 nA/mM glucose when the PLGA microsphere loading in the PVA hydrogel changed from 0 to 100 mg/ml, this reduced sensitivity is acceptable for sensor functionality. The changes in sensor response time and sensitivity were due to changes in glucose permeability as a result of the coatings. The embedded PLGA microspheres reduced the fraction of bulk water present in the hydrogel matrix and consequently reduced glucose diffusion.

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Abbreviations: (GOx) glucose oxidase, (MW) molecular weight, (PBS) phosphate-buffered saline, (PLGA) poly(lactic-co-glycolic acid), (Pt) platinum, (PU) polyurethane, (PVA) poly(vinyl alcohol)

Keywords: glucose biosensor, hydrogel, linearity, microsphere, response time, sensitivity

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Abstract cont.

Conclusions:

This study demonstrates that the PLGA microsphere/PVA hydrogel composite coatings allow sufficient glucose diffusion and sensor functionality and therefore may be utilized as a smart coating for implantable glucose biosensors to enhance their *in vivo* functionality.

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