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SYMPOSIUM

Bioluminescence Imaging of Glucose in Tissue Surrounding Polyurethane and Glucose Sensor Implants

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Abstract

Background:

The bioluminescence technique was used to quantify the local glucose concentration in the tissue surrounding subcutaneously implanted polyurethane material and surrounding glucose sensors. In addition, some implants were coated with a single layer of adipose-derived stromal cells (ASCs) because these cells improve the wound-healing response around biomaterials.

Methods:

Control and ASC-coated implants were implanted subcutaneously in rats for 1 or 8 weeks (polyurethane) or for 1 week only (glucose sensors). Tissue biopsies adjacent to the implant were immediately frozen at the time of explant. Cryosections were assayed for glucose concentration profile using the bioluminescence technique.

Results:

For the polyurethane samples, no significant differences in glucose concentration within 100 μm of the implant surface were found between bare and ASC-coated implants at 1 or 8 weeks. A glucose concentration gradient was demonstrated around the glucose sensors. For all sensors, the minimum glucose concentration of approximately 4 mM was found at the implant surface and increased with distance from the sensor surface until the glucose concentration peaked at approximately 7 mM at 100 μm. Then the glucose concentration decreased to 5.5–6.5 mM more than 100 μm from the surface.

Conclusions:

The ASC attachment to polyurethane and to glucose sensors did not change the glucose profiles in the tissue surrounding the implants. Although most glucose sensors incorporate a diffusion barrier to reduce the gradient of glucose and oxygen in the tissue, it is typically assumed that there is no steep glucose gradient around the sensors. However, a glucose gradient was observed around the sensors. A more complete understanding of glucose transport and concentration gradients around sensors is critical.

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Abbreviation: (ASC) adipose-derived stromal cell, (DMEM) Dulbecco's modified Eagle's media, (FBS) fetal bovine serum, (MEM) minimum essential medium, (NADPH) reduced nicotinamide adenine dinucleotide phosphate, (OCT) optimal cutting temperature, (PBS) poly(butylene succinate)

Keywords: adipose-derived stromal cells, bioluminescence, glucose profile, glucose sensor

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