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ORIGINAL ARTICLES

A Nanoporous, Transparent Microcontainer for Encapsulated Islet Therapy

Barjor Gimi, Ph.D.,[1,2,3] Joonbum Kwon,[2] Andrey Kuznetsov, M.S.,[4] Behroze Vachha, M.D., Ph.D.,[1] Richard L. Magin, Ph.D.,[3] Louis H. Philipson, M.D., Ph.D.,[4] and Jeong-Bong Lee, Ph.D.[2]

Abstract

Present-day islet encapsulation techniques such as polymer microcapsules and microelectromechanical system (MEMS)-based biocapsules have shown promise in insulin replacement therapy, but they each have limitations—the permeability characteristics of existing polymeric capsules cannot be strictly controlled because of tortuosity and the large size of present-day MEMS biocapsules leads to necrotic regions within the encapsulation volume. We report on a new microcontainer to encapsulate and immunoprotect islets/β cells that may be used for allo- or xenotransplantation in cell-based therapy. The microcontainers have membranes containing nanoslots to permit the bidirectional transport of nutrients, secretagogues, and cellular products while immunoprotecting the encapsulated cells. The 300-μm microcontainers were fabricated from an epoxy-based polymer, SU-8, with 50-μm-thick walls. Arrays of 25-nm wide slots were created in the SU-8 microcontainer lid. Isolated mouse islets were encapsulated in the microcontainer, and their physiological response to glucose was studied with fluorescence and two-photon imaging over 48 hours. The physiological response of the encapsulated islets was indistinguishable from controls. An agarose-filled microcontainer was imaged with magnetic resonance imaging to demonstrate the feasibility of future noninvasive, *in vivo* imaging. The SU-8 microcontainers maintained mechanical integrity upon islet loading and mechanical manipulation. Islet encapsulation, as well as the ability to visualize islet function within these transparent microcontainers, was demonstrated.

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Author Affiliations: [1]The University of Texas Southwestern Medical Center, Dallas, Texas; [2]University of Texas at Dallas, Dallas, Texas; [3]University of Illinois at Chicago, Chicago, Illinois; and [4]University of Chicago, Chicago, Illinois

Abbreviations: (Cu) copper, (E) electron, (FIB) focused ion beam, (KRH) Krebs–Ringer solution, (MEMS) microelectromechanical system, (MRI) magnetic resonance imaging, (MRM) magnetic resonance microscopy, (RF) radio frequency, (TEA) tetraethylammonium

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Corresponding Author: Barjor Gimi, Ph.D., The University of Texas Southwestern Medical Center, 5323 Harry Hines Boulevard, Dallas, TX 75390-9058; email address barjorg@yahoo.com