

Strategies to Improve the Oxygen Supply to Microencapsulated Islets

Comment on:

“Noninvasive Fluorine-19 Magnetic Resonance Relaxometry Measurement of the Partial Pressure of Oxygen in Acellular Perfluorochemical-Loaded Alginate Microcapsules Implanted in the Peritoneal Cavity of Nonhuman Primates“

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Strategies for islet encapsulation have progressed exponentially during the last decade. Innovative and biocompatible materials have been engineered for optimised islet immunoisolation as successfully demonstrated in small and large animal models.¹ Nevertheless, the inadequate oxygen supply to encapsulated tissue prevents the long-term survival and function of transplanted islets when implanted in highly efficient immunoprotective devices as previously described.² Unless the delivery of oxygen to encapsulated cells is not substantially improved, local graft hypoxia represents the major limitation to the translation of islet encapsulation into the clinical setting.

Although different mathematical models have suggested that the oxygen supply using macroencapsulation devices is inferior compared with microencapsulation techniques, the latter still requires substantial improvement in terms of oxygenation of the encapsulated cells.^{3,4} In their manuscript, Safley et al. present an interesting attempt to optimize oxygenation of microcapsules by implementing oxygen carriers into the encapsulation material.⁵ This group used an experimental model, that was first applied to different graft sites in rats,⁶ to measure the local oxygen levels in nonhuman primates using a noninvasive technique. Although a continuous decrease of the local pO_2 was noted in the peritoneal cavity during an observation period of 7 days, this approach enabled oxygen levels in or around the cell-free capsules that are higher as the pO_2 measured in the peritoneal cavity of different species.¹

To bring this concept closer to clinical application, experiments in nonhuman primates transplanted with islet-loaded microcapsules are essential in the near future to provide a proof of concept. In this context, previous observations, indicating that perfluorochemical-based oxygen carriers seem to have a detrimental effect on the

viability of encapsulated islets, have to be carefully considered.⁷ In order to manufacture alginate composites with a superior biocompatibility and a minimal pro-inflammatory potency, innovative materials with oxygen-delivering properties, such as the hemoglobin-related pigment from marine invertebrates, should be implemented in comparative studies.⁸

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