NanoBioReactor for Monitoring Small Cell Populations

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Technology description

Summary
NanoBioreactors recreate the micro environments of normal tissue, non-adherent cells, tumor-infected tissue and wounded tissue in vitro. These microfabricated bioreactors provide independent control of chemokine and growth factor gradients, shear forces, cellular perfusion and the permeability of physical barriers to cellular migration. This fine control allows detailed optical and electrochemical observations of normal, immune and cancerous cells during activation, division, cell migration, intravasation, extravasation and angiogenesis.

Description
Vanderbilt researchers have developed three types of bioreactors:
Actively perfused, instrumented NanoBioreactors for studying attached cells
Arrays of cell traps for studying small populations of adherent or non-adherent cells
Passive diffusion systems for the study of cell migration, differentiation and cellular/ organism interactions either in vitro or in vivo. A fourth class of vascular- perfused tissue micro environment is under development.

Potential Market Size
These devices present an opportunity to occupy and expand within the market shared by the transwell, Boyden, shear-flow and Dunn chambers. These devices provide new capabilities to the research laboratory market; they are small, inexpensive and disposable. A system that could control the tissue micro environment completely allows entry into the tissue research bioreactor market.

Current Competitive Products
Dunn, Boyden, transwell and shear-flow chambers are sold by a variety of firms. These devices are used to study a variety of cellular behaviors but are severely limited in their capabilities. Small companies offer niche perfusion products, while the larger commercial bioreactors are directed more towards the development of engineered tissue, not basic research into the tissue micro environment.

Competitive Analysis
Boyden and transwell chambers assess cellular migration across barriers. They provide:
An integrated fluorescence assay of migration across filters to allow quantitation of migration
Parallel plate flow chambers in which adhesion and rolling on endothelial cells in shear stress can be assessed
In vivo intravital microscopy in which migration of cells in living animals is visualized

All of these systems are unable to have sustained and controlled chemotactic gradients. Furthermore, they lack the ability to control all aspects of the experiments, e.g., having defined cell populations and controlled microfluidics for independent control of shear and tissue perfusion. The development of a motility/metastasis model system with independent control of endothelial shear stress, chemokine gradients, tissue perfusion and the ability to add different cell types through different ports, combined with state-of-the-art imaging techniques and sensor capabilities, would represent a huge advance over currently available systems.
With appropriate funding from a technology partner with demonstrated capabilities in development, production and marketing of low-cost cell culture devices, the ongoing studies could be extended to further the capabilities of the technique and refine the system platform. Researchers anticipate that approximately $500,000 and 18 months would be required to produce marketable prototypes of marketable devices.

Application area

This group of inventions offers potential both as a product line for cell culture devices, as well as an enabling technology for drug development, treatment assessment and optimization.

Institution

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