

Is there a predictable relationship between surface physical-chemical properties and cell behaviour at interface

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INTRODUCTION: The fate of implanted biomaterials is determined by the outcome of multiple interactions with various cell populations. When encountering a foreign surface, a cell may adhere and/or spread on the surface, or depart. Adhesion may affect cell survival, proliferation, differentiation, migratory or secretory behaviour. In order to draw optimal benefit from the huge amount of available data on material biocompatibility, it would be useful to elaborate and validate a general framework for correlating cell behaviour to material properties. While this is not feasible at the present time, the aim of this communication is to discuss three basic questions as a prerequisite for addressing this general problem. For the sake of clarity and homogeneity, we shall focus on mononuclear phagocytes that may be a suitable model to illustrate various issues : indeed, when encountering a foreign structures, these cells must decide whether they will trigger and or enhance inflammatory reactions. This decision is of both theoretical and practical interest.

PREDICTING ADHESIVE BEHAVIOUR. Will cell adhesion on an artificial surface be determined by nonspecific physical interactions or specific ligand recognition¹ ? In order to address this issue, it is necessary to consider the following questions : i) what is the difference between specific and nonspecific interactions² ? ii) To what extent do the nature and conformation of adsorbed macromolecules reflect the structure of underlying surfaces, or, stated in a different way, what does a cell actually see when encountering a foreign surface ? iii) Are there reliable methods for predicting the intermolecular forces between surfaces of known structure³ ?

SPREADING OR NOT SPREADING ? Spreading is a possible consequence of cell adhesion to a surface that provides a good model for understanding the consequences of adhesion since i) this process may be fairly rapid and can be quantified very accurately and ii) there is much evidence to support the view that spreading *per se* will influence further cell behavioural responses to foreign surfaces. Much evidence suggests that cell spreading may be influenced by deformability,

quantitative features of adhesion, and coordinated or random movements of the cell membrane. In view of recent experimental evidence, this process may be especially liable to quantitative modelling^{4,5}.

HOW DOES A CELL CHOSE BETWEEN DIFFERENT BEHAVIOURAL PATTERNS ?

In order to address this problem, we need consider the following questions : i) is it warranted to assume that cell stimulation may result in a few coordinated responses, or may gene activation follow multiple independent patterns ? ii) what is the respective role of specific chemical stimulation of a combination of membrane receptors, mechanical forces, cell shape, cytoskeletal and membrane domain organization in determining cell behaviour ? (note that all aforementioned parameters are not independent). During the last years, an impressive number of biochemically oriented studies disclosed multiple intracellular signalling cascades triggered by proper receptor stimulation. However, the well known complexity of non-linear networks and multiplicity of receptor species expressed by a given cell type makes it a fairly remote prospect to find a general relationship between stimulation of a given combination of surface receptors, intracellular biochemical events and ultimate cell response.

CONCLUSION: there is presently a need for unifying concepts to draw optimal benefit from the huge number of experimental data on cell behaviour at interfaces. This probably reflects the challenge presently met by cell biologists.

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