Biointerface as a key for the biomaterial development

Hyun-Man Kim
Laboratory for the Study of Molecular Biointerfaces, College of Dentistry,
Seoul National University

Anchorage-dependent cells should adhere to the solid surface before they establish the designated functions on the biomaterials such as spreading, migration, proliferation, and differentiation. Adherence of cells to the biomaterial surface is not just a mechanical contact, but it generates solid state signals from the surface like shown in the general cell adhesion-ligand interaction inevitably. Those signals from the surface can be specific enough to determine the behavior of cells on the surface in addition to being more or less non-specific to keep them alive preventing the activation of apoptotic signals. Solid state signals from the surface transmit to the intracellular signal transduction pathways through cell adhesion receptors most of which are integrins. Thus cells on the biomaterial surface mimic general cell-matrix interactions. Low wettability, hydrophobicity, of synthetic polymers has been recognized long time as a major obstacle against presenting anchorage-dependent cells with a condition for high cell acticity. Hydrophobic surface dose not provide a surface for cells interact with the surface to obtain the solid state adhesion signals. As results of insufficient adhesion signals, activations of Ras, Akt and ERK in response to FGF 1 were lower on the hydrophobic surface. Interestingly overexpression of activated Ras or Akt reversed low cell proliferation and high apoptosis in cells on the HB surface. It also made cell well spread on the HB surface. Furthermore overexpression of activated Ras and Akt activated ERK1/2 respectively and activated Ras overexpression activate Akt. These results indicate that Akt and ERK1/2 are independent downstreams of Ras and there is a cross-talk between these two pathways. Furthermore, a selective cell behavior on the biomaterial surface can be expected when simulating a specific biological cell adhesion receptor-ligand interactions. Increase in affinity or avidity of adhesion specifically can be achieved by implanting appropriate ligand(s) on the surface for the designated receptors of cells as well as carefully controlling divalent ions and or inside-out signals activating integrins. Thus biomimetism in ligard-integrin interaction will provide a guide for development of biomaterials.