Alteration of Leukocyte Surface Potential in Response to Chemotactic Agents

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Abstract

The polymorphonuclear leukocyte (PMN), like most other cells, exhibits a negative resting cell surface charge. This charge tends to promote cell separation through electrostatic repulsion. Upon stimulation, the cell's surface is altered such that the surface becomes more positive (less negative). Thus, the tendency to remain separate is diminished and the propensity to stick to other PMNs (aggregation) and endothelial cells (adherence) is increased. The change in the cell surface potential, and by implication the surface charge density, was measured by determining the change in partition coefficient for a charged probe molecule. The partition coefficient of a charged nitroxide spin probe (CAT-12) was quantitated through the use of electron spin resonance spectroscopy.

The technique developed is sensitive to surface potential and surface charge density changes as predicted by the Gouy-Chapman theory. In addition, the technique is not sensitive to transmembrane potential as demonstrated through the use of the potassium-selective ionophore, valinomycin, and through varying the extracellular potassium concentration.

PMN stimulation by the chemotactic oligopeptide N-formyl-methionyl-leucyl-phenylalanine (FMLP), was shown to cause a significant surface potential change ($p<0.001$) of at least 14 mV at 10 minutes after stimulation by 0.1 μM FMLP. The change reached a maximum of at least 21 mV at about 2 minutes after stimulation. It then decreased and remained essentially constant from 4 to 60 minutes. Morphometric analysis of transmission electron micrographs indicates a significant increase ($p<0.001$) in PMN surface area upon stimulation by FMLP. This increase results in an underestimate of the calculated surface potential change.

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