Effect of carbon nanotubes on transepithelial resistance in barrier epithelial cells

Shanta Lewis[1], Bonnie Blazer-Yost[1], Horia I. Petrache[2] and Torri Roark[2]

School of Science, Department of Biology[1], School of Science, Department of Physics[2]

Indiana University – Purdue University Indianapolis

Abstract

The burgeoning of the nanotechnology industry has revolutionized engineering, medicine and the fashion industry amongst many other technologies. The arrays of products that are synthesized from nanomaterials include high definition TV and computer screens, artificial organs, as well as antibacterial food containers. With these novel applications there is a paralleled concern of the negative implications of nano-material contamination in our environment and food chains. We are interested in carbon nanotubes because they are the most abundantly occurring nanoparticles that are found in the workplace. We have recently conducted studies in barrier epithelial cells to show that long single-wall and multi-wall carbon nanotubes (CNTs) caused a decrease in the transepithelial electrical resistance, a measure of the barrier function ,of renal principal cells at very low concentrations (0.4 ng/cm^2- 4 □g/cm^2). These results suggested that nanoparticles may also cause an effect on other barrier epithelial cells such as those lining the human digestive and respiratory tracks. After 48 hours of CNT exposure, to airway and colon cell lines, Calu-3 and t84 respectively, the calculated resistances were approximately half of the control monolayers', indicating that the barrier function of the tissue had been compromised, while the cellular monolayer remained intact. We sought to determine the mechanism of action of the nanoparticles, by investigating the interaction of CNTs with model lipid membranes using a bilayer clamp amplifier. Measurements showed that the presence of nanoparticles caused transient disruptions in lipid membranes made of phosphatidylcholine lipids. Nanotubes also caused transient interruptions in the current allowed by the ion channel reporter (gramicidin A). These results began to elucidate the mode of action of the particles and indicated that it is important to develop a complete understanding of how nanoparticles interact with cells if we are to safeguard against changes that these materials will cause *in vivo*.