Toward Breast Cancer Therapy and Early Tumor Detection: Receptor Mediated Cellular Uptake of Platinum Folate Nanoparticles and Their Influence on Cellular Mechanics

Breast cancer accounts for nearly one in three cancers among women in the United States. Conventional therapies used to treat breast cancer do not effectively differentiate between cancerous and non-cancerous cells, leading to the destruction of healthy cells as well as tumor cells during treatment. The purpose of this investigation was to detect and target breast cancer cells based on differences in the membranes of cancerous and non-cancerous cells, especially differences in folate receptor expression and membrane mechanics. Certain overexpressed receptors in tumors are potential targets for nanoparticle treatments; for example, cancer cells have over five hundred times more folate receptors than healthy cells. There are also fundamental differences in terms of phospholipid bilayer membrane rigidity; the tumor cell membrane is less rigid than that of the healthy cell. This justified an investigation to determine whether coating platinum nanoparticles with folate would lead to selective increased nanoparticle uptake in MCF-7, a cancerous breast cell line, compared to MCF-10A, a non-cancerous breast cell line. After exposure to nanoparticles for 48 hours, the cells were analyzed using transmission electron microscopy to observe membrane structure, and for differences in membrane rigidity using atomic force microscopy. It was found that the cytotoxic effects of platinum folate nanoparticles in MCF-7 include nanoparticle localization in vacuoles and the disintegration of the membrane, while these effects are less prominent in MCF-10A. These findings are key in the development of folate-targeted cancer treatment, improving tumor-targeting specificity.