JOINT BIOENGINEERING SEMINAR SERIES

"A Working Hypothesis to Explain the Role of Charge Relaxation in the Progression of Tissue from Benign to Cancer"

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Sep. 8, 2017, 12:00-12:50pm UWM EMS E237

Abstract:

NovaScan has conducted research on the properties of benign and cancerous breast tissue since 2003 in a study entitled 'EPET I' performed at various sites of the Aurora Health Care system. A significant result of this research is that the rate at which a cell redistributes electrical charge deposited on the cell by a small externally produced electric field ($F_{relaxation}$ (Hz)) is up to 1000 times greater for cancer vs benign cells. We hypothesize that this phenomenon may well be a universal property of cells as they transform from normal (benign) to cancerous and that, further, the transformation process produces disordered cellular material that causes reduced electrical polarization of the cell contents.

We have created a model based on this working hypothesis to explain our results. A review of our relevant data will be followed by a development of the model from our results and the reported results of other groups that have performed complementary research on cell suspensions and single-cell measurements of the electrical properties of breast cell lines. Further evidence supporting this hypothesis is obtained from optical scattering experiments of a disorder parameter that show organ-wide alteration of the order of the cell at the nano-architecture level that seems to be a general event in carcinogenesis, which is supported in three further types of cancer: colon, pancreatic, and lung. More recent measurements by our group on non-melanoma skin cancer (basal cell and squamous cell cancers) further support the model. All of these results are believed to also be related to the Field Cancerization Theory proposed by Slaughter in 1953, stating that "Cancer does not arise as an isolated cellular phenomenon, but rather as an anaplastic tendency involving many cells at once".

The presentation will end with a review of 8 years of follow-up data on EPET I patient outcomes that is confirmatory to the working hypothesis. These retrospective data show that $F_{relaxation}$ can be used to predict the possibility of re-occurrence of cancer, as well as an estimate of the length time of survival after re-occurrence, all based on the measured value of $F_{relaxation}$ at the time of the surgery.

Bio:

Professor William Gregory is a native of Pittsburgh, PA, who received a BS in Physics from Georgetown University in 1961 and a PhD in Physics from MIT in 1966. After faculty positions at Georgetown University, the Universität Tübingen, Germany, (as an Alexander von Humboldt US Senior Scientist Fellow), and Clarkson University, he went over to the dark side and held joint faculty and Dean positions in the College of Science and Engineering, Gannon University; the Leonard C. Nelson College of Engineering at the West Virginia University Institute of Technology; and Senior Associate Dean of the College of Engineering and Mineral Science, West Virginia University. In addition, he worked in industry for Westinghouse Inc., Raytheon Inc., and Wandel und Goltermann, GmbH, (Germany) and 6 start-up high tech companies. In 2000 he was appointed Dean of the College of Engineering and Applied Science at UWM. He stepped down as Dean of CEAS in 2005 but remained on the faculty in the Electrical Engineering Department, along with a joint appointment as a Professor in the College of Health Sciences, until 'retiring' from UWM in 2010. He was a co-founder of NovaScan LLC (now NovaScan Inc.) in 2003 and is currently the Chief Science Officer and Board Chair of the Company. His lifelong research interests have been in the electrical properties of matter, more recently in the electrical properties of human tissue.