A THEORETICAL AND EXPERIMENTAL APPROACH OF CELL MEMBRANE ELECTROSTATICS AND TRANSPORT

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Introduction

In cancer, neoplastic cells can develop resistance to a variety of drugs, even to those drugs that cells have never come across. [Roepe, 1998] [Roepe, 1999] [Roepe, 1993] This makes the cancer therapy even more demanding and challenging, as clinicians have to take into consideration that the heavy medication they administer to the patients can be ineffective. This phenomenon acts as a motivation to explore the mechanisms behind molecular transport across the cell membrane.

Methods

Using cancer cells and fluorescent dyes, we can detect experimentally whether a dye molecule can enter the cell. The most important aim of this research work is to detect whether there is a link between physical parameters of the cell, like the membrane charge density and the ionic accumulation, and the molecule's transport. [Rauch, 2009] We then build a mathematical model to explain and predict what happens during the experimental procedure. [Richardson, 2009]

Results

Our experiments show that the dye's crossing is influenced by alteration of the membrane potential. In details, when the difference in potential across the membrane increases, then more dye molecules cross the membrane. In details, when the difference in potential across the membrane increases, then more dye molecules cross the membrane. Using our mathematical approach, we approximate the dye crossing the cell membrane via competition between diffusion and electrostatic forces. In that way, we are able to predict a molecule's movement from the outside to the inside of the cell when the potential, the distribution of ions and the electrostatic properties of the membrane are known. Furthermore, it is possible to predict the transport time of the molecule as well as its distribution in the vicinity of the membrane area.

Discussion

From this work, we are able to predict how a molecule can cross the membrane, if physical properties of the cell are known. This could be used in cancer therapy, if a detailed study of tumour cells is available.

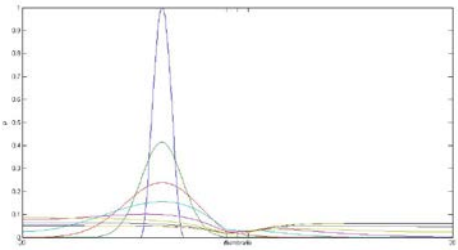

Figure 1: Distribution of the dye in the vicinity of the membrane, where P is the probability density and x is the axis transverse to the membrane.

References

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