CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Rohan Arora; Venkat V. Krishnan

Project Number

S0505

Project Title

Designing an Innovative Multi-Faceted Smart Drug for Lung Cancer: Revolutionizing Targeted Cancer Treatment

Abstract

Objectives/Goals

Lung Cancer is the leading cause of all cancer deaths, with a 5-year survival rate of only 17%. Lung Cancer does not display surface proteins associated uniquely with tumor cells; thus it is impossible to rely on the traditional use of antibodies to design highly selective drugs for lung cancer. Further, current methods that target over-expression of proteins or inhibit pathways also destroy healthy cells.

The goal was to overcome the limitations of current techniques and design a drug targeted to structural mutations expressed by tumor-associated surface proteins, combating the lack of tumor-unique markers in Lung Cancer, and opening a new frontier in cancer treatment.

Methods/Materials

First, the Mutant-EGFR was identified as a potential target due to its prominence in tumor cells. Geometric Probability Theory led to the hypothesis that Small Molecules will effectively target isolated changes in protein structure, differentiating between mutant-EGFR and the healthy wild type. Conformational analysis of a virtual binding study conducted in VINA predicted a set of small molecules specific for the L858R mutation and a set specific for an exon-19 deletion of EGFR. The molecules were acquired and conjugated to a carrier protein to form a multifaceted hapten-protein conjugate (as verified in Native-Page Gel Electrophoresis). Multiple ELISAs were conducted to confirm the specificity of the conjugate to both tumor-associated mutant EGFRs. A cell-binding study is in progress to validate drug selectivity via fluorescent microscopy.

Results

The multifaceted conjugate was successfully designed and displays high selectivity for both EGFR mutations based on results from multiple ELISAs. Early results from the cell-binding study further demonstrate the ability of the molecular vector to differentiate between cancer and healthy cells.

Conclusions/Discussion

This project describes a novel application of small molecules to design a molecular vector that differentiates between cancer and healthy cells with similar surface proteins, eliminating any side effects in patients. The design has been applied to develop a targeted therapeutic agent for Lung Cancer that can be used for tumor-specific delivery of cytotoxic drugs.

The level of comfort and specificity ensured by this treatment has the potential to drastically increase patient survival, preventing 1.8 million deaths annually and revolutionizing cancer treatment.

Summary Statement

The original design and assessment of an advanced targeted therapy for Lung Cancer is described. The mechanism is universally applicable to revolutionize cancer treatment.

Help Received

The idea for the project as well as the work and analysis is completely original. The only assistance received was in the ordering of compounds to our school. Work was performed on rented equipment at a community laboratory.