CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Jessika Baral

Project Number

36380

Project Title

Small Cell Lung Cancer Detection Using Nuclear Factor I/B Expression: Increase Patient Survival in 1 Minute for 1 Dollar

Abstract

Objectives/Goals

Around 1.6 million people die annually from lung cancer--about 3 every minute. Small cell lung cancer (SCLC) is the most fatal and aggressive subtype of lung cancer due to the rapid onset of metastases. Current diagnostic processes stain biopsies for general markers, not metastasis-specific ones; thus, treatment is not patient-specific and there could be misdiagnoses. The objective is twofold: A. find out if Nuclear Factor I/B (NFIB) plays a role in small cell lung cancer metastases and if so, B. form a machine learning tool that can detect SCLC based on NFIB expression.

Methods/Materials

Immunohistochemistry assays of primary lung tumors and metastatic liver tumors were done to find out where NFIB expression was concentrated. To understand how NFIB expression changes during progression, tumors were randomly tagged with GFP, RFP, or CFP (green, red, or cyan fluorescent protein); those with partial NFIB expression were analyzed in detail for their origins from one tumor or two based on the fluorescent protein staining of the same tumors. Overexpression and knockdown cell lines were made and verified with western blots. Alamar blue assays were used to find the functional role of NFIB by growth analyses. Finally, human NFIB-stained SCLC biopsies were analyzed using a bioinformatics image-processing algorithm to correlate NFIB expression with stage of SCLC. The machine-learning algorithm was trained using NFIB positive and NFIB negative images.

Results

High expression of Nfib is enriched in SCLC metastases. NFIB expression originates from within NFIB negative tumors, not separately, indicating NFIB expression is selected for in the metastatic process. Alamar blue assays indicated overexpression of NFIB enhanced the growth whereas knockdown decreased growth. Results also showed NFIB expression level is representative of the stage of cancer; the tool is very accurate: over 99% sensitive and specific in classifying biopsies.

Conclusions/Discussion

Upon Nfib knockdown, the number of metastases decreased, highlighting the therapeutic potential of inhibitors of Nfib or its downstream effectors. Doctors can directly use this machine-learning tool to, within 1 minute, learn about the metastatic potential of patients' tumors or more accurately diagnose SCLC for one dollar per test. This knowledge can increase patient survival by years.

Summary Statement

I determined the significant role of Nuclear Factor I/B in Small Cell Lung Cancer (SCLC) metastases and made a tool to more accurately diagnose SCLC and understand the metastatic potential of tumors for 1 dollar in 1 minute.

Help Received

I carried out all the assays and wrote the machine learning algorithm for my detection tool. My mentor, Professor Julien Sage from Stanford University, only answered any questions I had regarding new procedures.

Preliminary