A Mathematical Model to Predict the Impact of Chemotherapy on Risk for Richter Syndrome in Patients With Chronic Lymphocytic Leukemia

Lee, Ethan (School: Thomas Jefferson High School for Science and Technology)

Richter Syndrome (RS) is a sudden complication that can occur in 2-10% of Chronic Lymphocytic Leukemia (CLL) patients where a second, much more dangerous and aggressive lymphoma can spring up from the original CLL cancer cells. Like other cancers, the onset of RS involves the acquisition of sequential genetic changes over a period of time. However, no quantitative models to predict risk of RS currently exist, which has the consequence of a lack of understanding of the extent to which certain risk factors can impact risk for RS. One especially problematic example of this is that many therapies aimed to cure CLL are mutagenic, and thus could expedite the mutations needed for RS to occur and lead to earlier death for the patient. Here, I built upon the math from the multistage model for carcinogenesis to create a new mathematical model that takes CLL cell dynamics and CLL therapies into account to model risk of RS over time. I then used my mathematical model along with clinical data to predict the number of mutational steps necessary for RS to occur. Finally, I also used my model to analyze the situations where a certain form of CLL therapy will increase or decrease general risk for RS, and propose a method to make better informed decisions to prolong a patient's survival when treating CLL.

Awards Won: