Rational Development of a Therapeutic Peptide Vaccine Targeting Tumor-Specific Antigens in Neuroblastoma

Anubhav Biswal, Carmel High School, Carmel, IN, USA

Q1: PROBLEM

- Neuroblastoma is a brain cancer affecting immature nerve cells (neuroblasts)
- Cancer goes undetected in the body, making it grow

-OBJECTIVES:

- Identify tumor specific antigens (epitopes) that immune cells can detect for cell response
- Find binding sites on B-Cells that Epitope will attach too

HYPOTHESIS:

- Epitope 1 on neuroblastoma will bind strongest to the B-Cell and be used for the peptide vaccine

Q2: Methodology/Project Design

- Immune Epitope Database gave 5 potential epitopes that could bind to immune cells
- AlphaFold3 and P2Rank showed the 3-D B-Cell receptor and its predicted binding site
- Gramm and PLIP showed the actual epitope-B-cell bonding and interactions
- ScanNet and ChimeraX showed us valuable visuals on B-Cell receptor, the epitope structure, and BCR-Eptiope binding

GRAMM Show the B-Cell and ligand (epitope) binding as shown in the picture

Shows 3-D model of the B-Cell receptor and predicted binding site that epitopes will bind to.

Q3: Data Analysis & Results

- CD79a and CD79b identified as tumor specific targets on the B-Cell receptor (BCR)
- Epitope 4 was found to bind strongest to BCR with most hydrophobic/hydrogen bonding
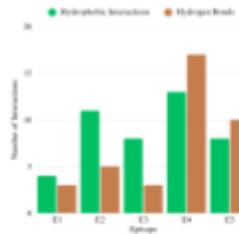
Graph (from PLIP analysis) shows E4 having the most interactions with the B-Cell proving its the strongest epitope
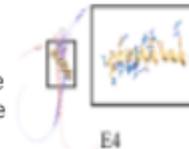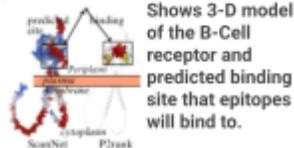
Image here shows the unique structure of epitope 4 and its binding on CD79a and b on the B-Cell receptor.

Q4: Interpretation & Conclusions

- Hypothesis denied, originally as E1 binding strongest to B-Cell receptor and will be used to advance vaccine
- Because of strong B-Cell and E4 binding, B-Cell can mark tumor with antibodies, which killer T cells will recognize and kill cancer through Apoptosis (programmed cell death)
- E4 can be advanced and modified to become the official Neuroblastoma vaccine allowing immune cells to recognize tumor
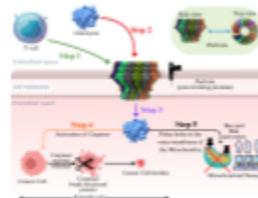
Shows process of how the killer T-Cell can release certain proteins allowing Neuroblastoma to undergo Apoptosis (programmed cell death) and kill the cancer