



CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

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Project Title Correlating Inflammatory Markers and the Development of Neurodegenerative Lesions Using Machine Learning	
<p style="text-align: center;">Abstract</p> <p>Objectives The purpose of this project was to determine if machine learning algorithms could predict the development of neurodegenerative lesions found in a subset of patients diagnosed with Langerhans Cell Histiocytosis (LCH). Neurodegenerative lesions are a devastating late-effect that develops in some patients diagnosed with LCH, yet the overall incidence remains unknown. By using specific data in a patient's medical history, including inflammatory markers and the location of other LCH lesions throughout the body, the overall likelihood of a patient developing neurodegenerative lesions can be determined. These high-risk patients can therefore be more closely monitored, allowing for earlier detection and intervention with life-saving treatments.</p> <p>Methods Data were acquired from parents of 213 patients that are members of a closed LCH group on Facebook. The data included age, gender, birth month and location, type and location of LCH lesion, and blood markers such as complete blood count, sedimentation rate (inflammatory marker) and vitamin D levels. Patients also reported whether they had been diagnosed with neurodegenerative disease and a subset provided brain MRIs. Two types of software were used, including OsiriX for MRI analysis, and MATLAB for machine learning and feature identification and extraction.</p> <p>Results Approximately 11% of patients reported a diagnosis of neurodegenerative lesions. We were able to independently discover the presence of neurodegenerative lesions in additional patients by using their brain MRIs in our feature detection algorithm, bringing the overall total to 14% of all LCH patients. Neurodegenerative lesions were present in 53% of LCH patients who had previous cranio-facial lesions or pituitary involvement, and in 68% of patients who had these specific lesions in addition to elevated inflammatory markers 1 year after chemotherapy treatment ended. We found no correlation between vitamin D level and presence of neurodegenerative lesions.</p> <p>Conclusions Our risk calculator resulted in 0.83 sensitivity and 0.68 specificity; the number of false negatives was 2% and the number of false positives was 11%. Based on these results, we recommend that patients with cranio-facial or pituitary lesions, who also have elevated inflammatory markers 1-year after chemotherapy treatment ends, should be more closely monitored in order to initiate early preventative treatment.</p>	
Summary Statement We determined which patients diagnosed with Langerhans Cell Histiocytosis were most likely to develop neurodegenerative lesions based on the location of prior lesions and developed a machine learning algorithm to predict their 5-year risk.	
Help Received Sigrid Close taught us how to code in MATLAB and helped with the online data gathering. Nicolas Lee advised us about different types of machine learning algorithms.	