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Artificial Intelligence for Reading of Hirschsprung Disease Pathology Slides

Final Abstract
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Abstract

Hirschsprung disease is a congenital condition of intestine innervations present in 1 in 5,000 newborns. The disease results in a lack of ganglion cells in the area of the myenteric (Auerbach) plexus and submucosal (Meissner) plexus in the distal section of the large intestine in an infant. The absence of the ganglion cells causes muscles in the bowel to lose their ability to move stool through the intestine as well as submucosal nerve hypertrophy. The main treatment is pediatric surgery to remove the affected bowel segment. Precise and quick diagnosis of the disease is the key to accurate treatment. The diagnosis is done mainly by biopsy of the affected bowel. From the biopsy, the complete absence of ganglion cells in the submucosal or intramuscular nerve plexus of the intestinal wall and the presence of hypertrophic nerve fibres and trunks has to be confirmed by a pathologist. There are some difficulties associated with the diagnosis and the proper recognition of ganglions cells, even with proper training. These issues are exacerbated in developing countries due to a lack of pathology technology and talent. In this project, QuPath and Python have been used to identify ganglion cells within patient rectal biopsy samples to aid in the diagnosis of Hirschsprung disease and improve pathological analysis at Children's National Hospital. A random forest classifier was built in QuPath to correctly identify ganglion cells. Then, an automation script was coded in Groovy to streamline the process of detecting all cells, identifying ganglion cells with the classifier, and outputting cell measurements within QuPath. Using Python, we ran a correlation study to determine which features best separated ganglion cells from other cells. We built three additional classifiers in Python and compared to our QuPath classifier. The QuPath classifier outperformed all 3 in sensitivity, but had a lower precision in detecting ganglion cells. The artificial intelligence program developed by our project can be incorporated into an application that can be used worldwide to improve the quality of care of Hirschsprung disease globally. With further collection of samples an important database can be built while protecting patients data and rights and respecting their anonymity and confidentiality.