Fully Automated Algorithm to Detect Vascular Leakage in Uveitis

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Objective: To develop a fully automated algorithm to detect and calculate vascular leakage on fluorescein angiogram

Purpose: Fluorescein angiography, the gold standard for imaging retinal vasculature and detecting abnormalities like vascular leakage is frequently used to manage diagnose and manage retinal and uveitic disorders, however interpretation is highly subjective, which limits the utility of fluorescein angiography as clinical trial endpoints. We aimed to develop a fully automated algorithm to detect and calculate areas of vascular leakage in uveitis patients.

Methods: We selected and annotated 200 images from uveitis patients. A deep-learning algorithm with a U-Net architecture was trained and used for vascular leakage segmentation. We trained our algorithm with 200 images and their manual annotations (the ground truth), then used the trained algorithm to detect leakage on unmarked fluorescein angiogram images. The training workflow consisted of augmenting images, augmenting the annotated portions of images, cropping them into smaller images, and using the smaller images as inputs for training the deep learning model. To assess concordance between algorithmic segmentation and the manual annotation, we used the Dice Similarity Coefficient (DSC), a measure of concordance that range from 0 (no overlap) to 1 (perfect overlap). We calculated inter-rater reliability using 20 images that 2 graders independently annotated and assessed concordance between the two graders.

Results: We developed an algorithm with a best average DSC of 0.57. We also found high variability between graders, with an average DSC of 0.37. The concordance of the algorithm was higher than the concordance between human graders. Additionally, the algorithm was able to detect clinically significant changes (upon treatment) on angiograms with high sensitivity (90%) and specificity (90%) (AUC: 0.95).

Conclusions: We were able to develop a fully automated algorithm to detect and calculate areas of leakage which also was able to detect clinically significant changes with high accuracy. Though this algorithm requires further development, this work is a beginning step to developing a robust automated system for detecting vascular leakage in uveitis.

Algorithm Leakage Detection Results – Figure 1