

Proof of concept for a deep learning algorithm for identification and quantification of key microscopic features in the murine model of DSS-induced colitis

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BACKGROUND

Inflammatory Bowel Disease (IBD) is a debilitating disease for which no cures exists. Murine models are widely used to study IBD. Amongst them, the DSS-colitis model is a rapid and reliable one to represent associated diseases such as ulcerative colitis and Crohn’s Disease. However, manual scoring of histopathological lesions is challenging.

STUDY DESIGN

The goal was to develop a CNN-based AI model to assess acute inflammation in colon sections of DSS-induced colitis to improve and accelerate the screening of candidate IBD compounds.

Sample Preparations

- Dextran Sulfate Sodium (DSS) model of ulcerative colitis in C57BL6 female mice
- 3% DSS in water from days 1-8



Image Analysis Software and CNN Training

- 3 training sets using whole slide images (WSIs) of H&E stained colon segments
- 23 slides used for training and annotations; 65 slides total
- 3 nested individual AI models run in sequence, 6 classes total
- Manual training annotations of <5% of colon surface, followed by manual adjustments of AI generated annotations

WORKFLOW

1 In life assessment of colitis induction

Body Weight and Disease Activity Index representing clinical manifestations of disease in the mice.

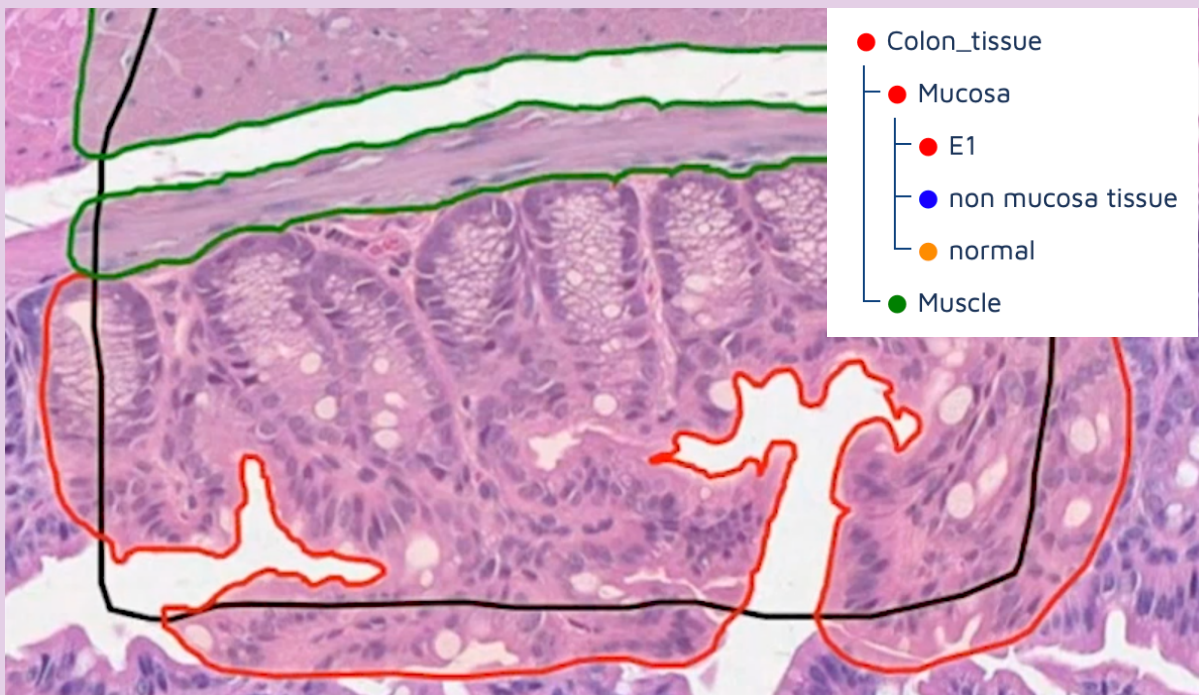
2 Slide Acquisition

Stretched colon sections with H&E staining and fixed with formalin. Slides scanned and uploaded to Aiforia Cloud.



3 Training annotations

Training set chosen from three groups of mice: Naive (water), DSS (vehicle), Cyclosporine A (treatment). Annotations were run in sequence by nested layers, beginning with colon tissue and divided into subcomponents. Visual quality checks on training and test sets.



4 Neural network training and verification

Aiforia Create software used to train AI model. Results compared to initial annotations with manual adjustments as needed.

5 Deploy the AI model to new images



Fig 1. Mouse colon from naive animal; AI classification of muscle (green) and mucosa (red).

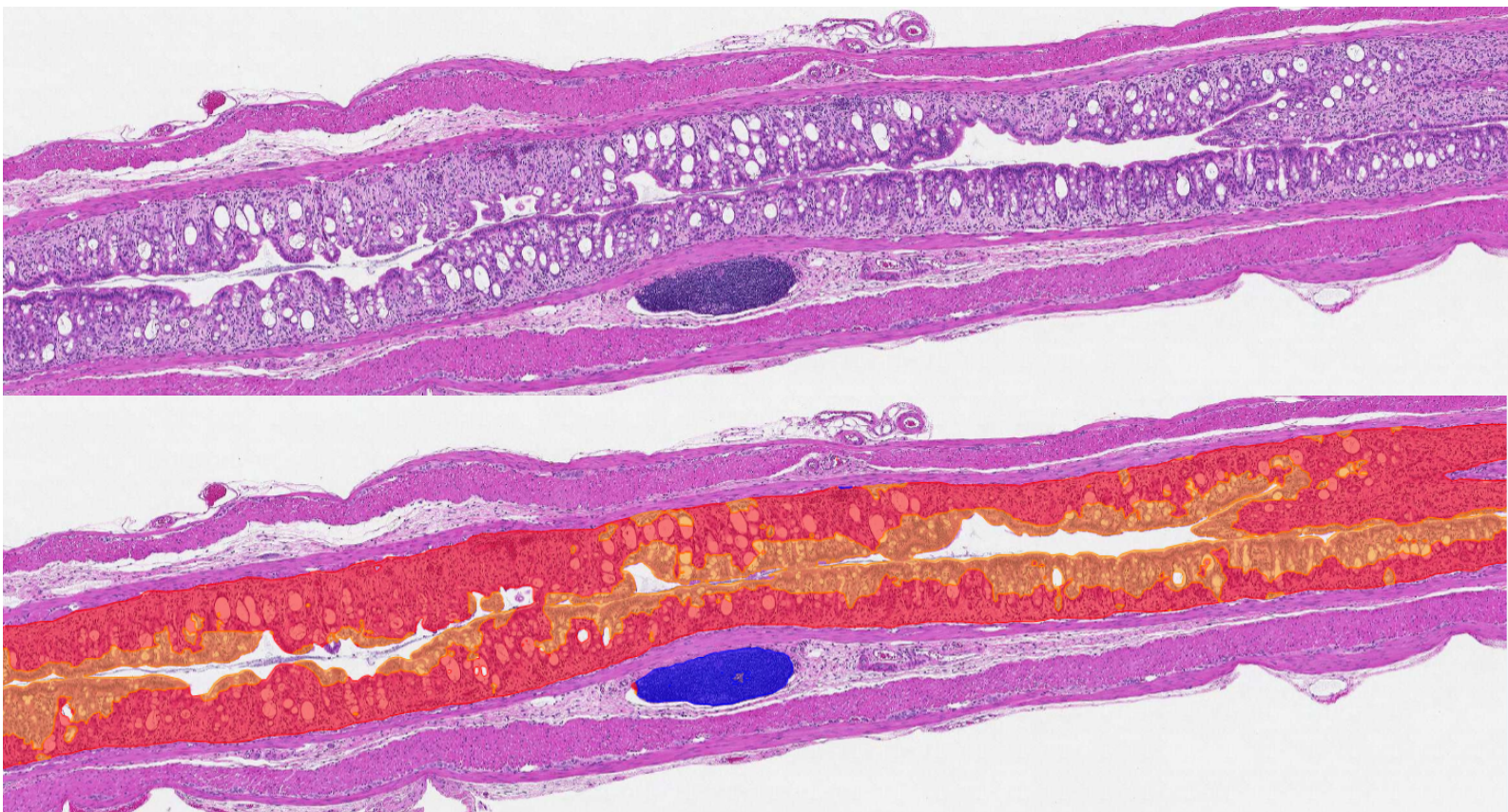
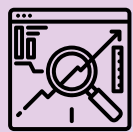


Fig 2. Mouse colon from vehicle DSS animal; AI model classification of acute inflammation (red), normal mucosa (orange), and nonmucosa gut-associated lymphoid tissue (blue).

BENEFITS OF AI ANALYSIS



Eliminate laborious or repetitive tasks for pathologists



Provide decision support for the identification of findings



Cloud based software for low entry point and supports remote access

RESULTS

Trained deep learning algorithm developed with Aiforia Create accurately identified and segmented key tissue layers and microscopic features of DSS colitis model with a high confidence level in all 3 groups of mice. (Fig 1. & 2.) The AI algorithm demonstrated the possibility to translate a visual score into an AI-assisted score better suited for statistical analysis, and allowed for use of an entire colon section including tissue commonly excluded in traditional methods.

To access the images and results directly on the Aiforia software without a subscription, follow the instructions [here](#)

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