Deep Learning Convolutional Neural Network Can Differentiate Between Most Clinically Relevant Patterns of Colitis

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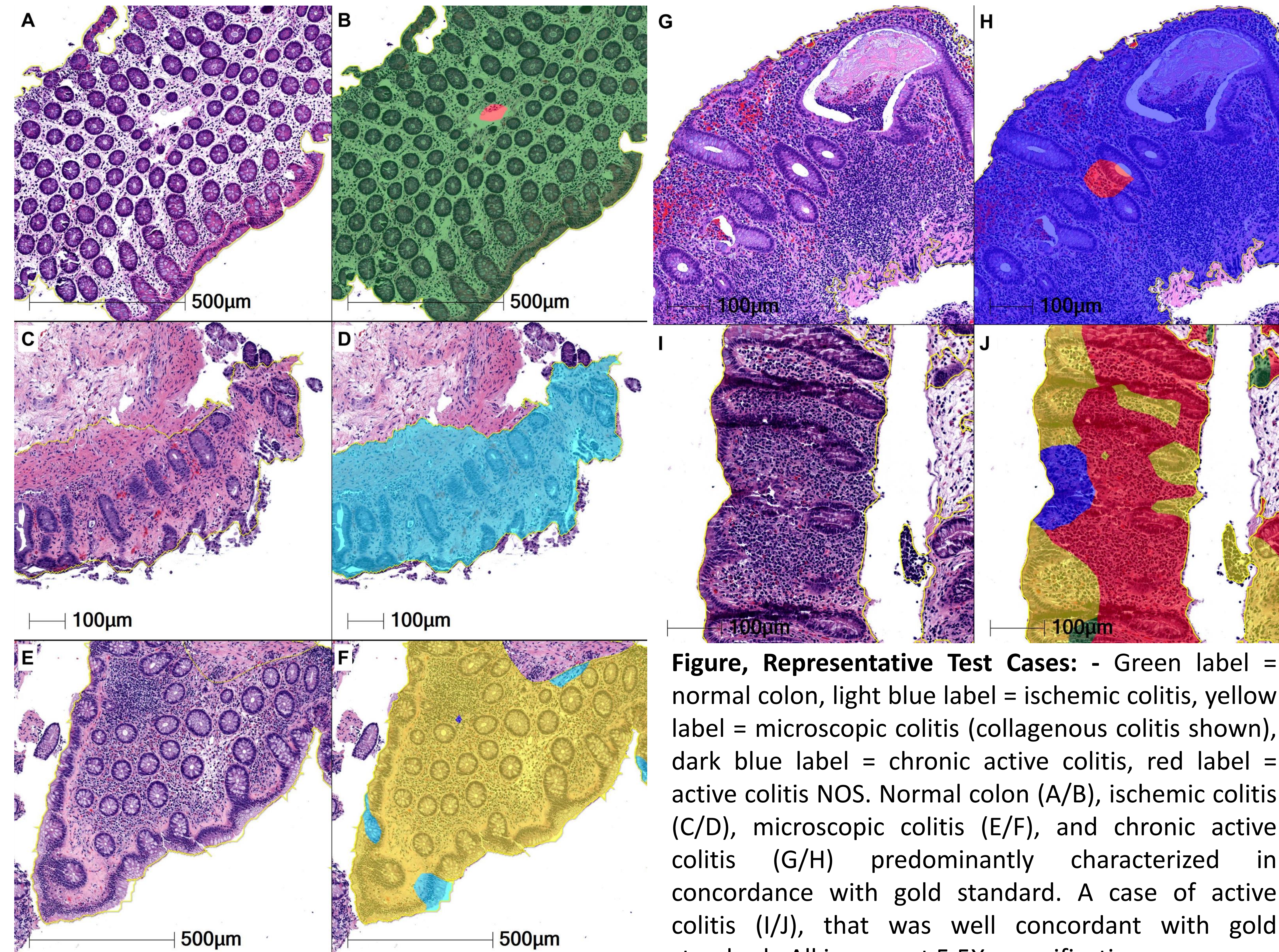
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Introduction

There are no studies evaluating the ability of a convolutional neural network (CNN) to recognize various patterns of colitis. We investigate whether a CNN can differentiate between different types of colitides, including: active colitis not otherwise specified (AC NOS), microscopic colitis (MC), chronic active colitis (CAC, AKA inflammatory bowel disease pattern), and ischemic colitis (IC), as well as histologically normal colon (NC).

Materials and Methods

312 cases were reviewed by 2 gastrointestinal (GI) pathologists to establish gold standard consensus diagnoses. The cases were then scanned and analyzed by HALO-AI (Indica Labs, Albuquerque, NM) via randomizing 198 (63%) to a training set (AC NOS=46, CAC=52, IC=30, MC=40, NC=30) and 114 (37%) to a test set (AC NOS=14, CAC=34, IC=20, MC=26, NC=20). A HALO-AI correct area distribution (AD) cutoff of ≥ 50% was required to credit the CNN with a correct diagnosis.

Results

Overall, the CNN results were 87% concordant with the gold standard diagnoses (99/114). CNN accuracy rates for each diagnostic category were as follows: AC NOS=43% (6/14), CAC=91% (31/34), IC=95% (19/20), MC=88% (23/26), and NC=100% (20/20) (Figure, A-J).

Figure, Representative Test Cases: - Green label = normal colon, light blue label = ischemic colitis, yellow label = microscopic colitis (collagenous colitis shown), dark blue label = chronic active colitis, red label = active colitis NOS. Normal colon (A/B), ischemic colitis (C/D), microscopic colitis (E/F), and chronic active colitis (G/H) predominantly characterized in concordance with gold standard. A case of active colitis (I/J), that was well concordant with gold standard. All images at 5.5X magnification.

Conclusions

A CNN can differentiate most clinically relevant patterns of colitis as well as normal colon histology. Although it struggles with the pattern of AC NOS (which could limit its usefulness in clinical practice), AC NOS is not often biopsied and is usually diagnosed clinically. Because a CNN can most accurately identify NC vs. colitis in general, it may best be implemented as a screening tool to improve efficiency for large GI pathology groups.

References

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