Deep learning and device-assisted enteroscopy: automatic detection of pleomorphic gastrointestinal lesions in device-assisted enteroscopy.

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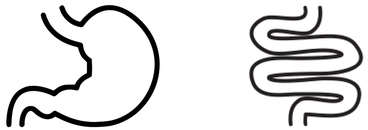
Introduction

Device-assisted enteroscopy (DAE) allows deep exploration of the **gastrointestinal (GI) tract**, enabling tissue sampling and the application of endoscopic therapy. **Convolutional Neural Networks (CNNs)** are a **multi-layer** artificial intelligence architecture with **high performance** levels for **image analysis**.

Our group **aimed** to **develop** and **test** a **deep learning** algorithm for the detection of **multiple pleomorphic** gastrointestinal lesions in DAE, namely **vascular lesions** (angiectasia, varices, and red spots), **protruding lesions** (polyps, epithelial tumors, subepithelial lesions, and nodules), **ulcers** and **erosions**.



Methods and Materials

A total of **260 DAE** exams from a single center were included to **develop** a CNN capable of **automatically detecting multiple gastrointestinal lesions**.

Selected images of gastrointestinal lesions were inserted into a **CNN model with transfer learning** (n = 22976). **A training dataset** was used to develop the model (80% of the entire image dataset, n =18380). The network's performance was evaluated using an **independent dataset** (20% of the entire image dataset, n = 4595).

The output provided by the network was compared to a consensus classification provided by **three gastroenterologists** with experience in DAE.

The network's performance was evaluated by calculating its **sensitivity**, **specificity**, **accuracy**, **positive predictive** and **negative predictive values** (PPV and NPV, respectively), and **area under the receiving operating characteristic curve** (AUC).

Results

After optimization of the neural architecture, our model presented the following metrics:

Sensitivity	96.2%
Specificity	95.0%
Positive Predictive Value	95.6%
Negative Predictive Value	95.7%
Overall accuracy	95.6%
AUROC	1.00

A **subanalysis** of the CNN performance in each **subgroup** (vascular lesions; ulcers/erosions; protruding lesions; blood/hematic residues) was performed. The neural network excelled in all the subgroups, with the best results in the subgroup of blood/hematic residues (overall accuracy of 99.3%) and the worst performance in the detection of ulcers and erosions (overall accuracy of 93.8%).

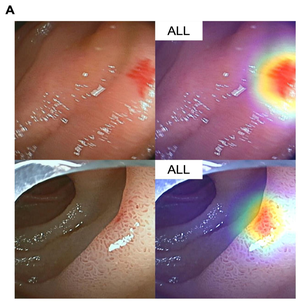


Figure A: Heatmaps showing features detected by the convolutional neural network.

Discussion

Our group **developed and validated** a pionner AI algorithm for the **automatic detection of pleomorphic lesions in the GI tract during DAE.** Multicentric studies are required for the further development and clinical validation of the AI role in DAE. Neverthless, the development of these tools may enhance the diagnostic yield of DAE.

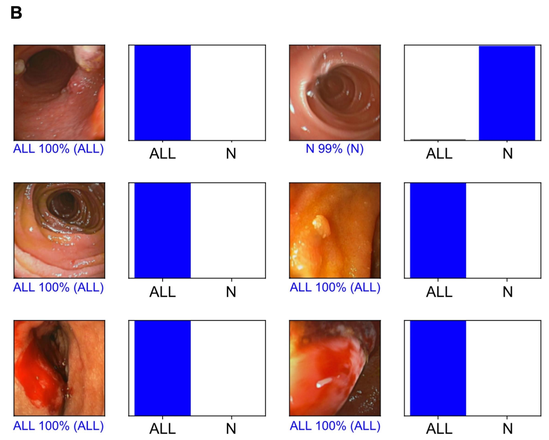


Figure B: Output obtained from the application of the CNN. A blue bar represents a correct prediction. ALL – lesions; N – normal.

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