Detection of Superior Mesenteric Artery Occlusion on Abdominal CT Using a Machine Learning Model

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Introduction

The superior mesenteric artery (SMA) branches from the aorta and is a major arterial supplier of the intestines. Occlusion of the SMA often results in bowel ischemia which can lead to severe morbidity or death. SMA occlusion can be missed on abdominal CT in clinical practice. Our radiology practice processes a high volume of abdominal CT studies and developing a screening tool for this pathology could improve patient care.

Hypothesis

We hypothesized that by training a bounding box-based machine learning model on a labeled dataset of both occluded and non-occluded SMA studies, this model could be used to prospectively screen patients for SMA occlusion (SMAO).The results could then be used in a quality assurance (QA) pipeline. We also hypothesized this model could be implemented with high specificity to avoid a large number of false positives in a high-throughput setting.

Methods

A natural language processing (NLP) model was used to select 142 retrospective post-contrast abdominal CT studies from our database that were positive for SMAO. The occlusions on each slice in these series were segmented by a radiologist and the segmentations were converted into bounding box data. A total of 1,286 images with SMAO were used. Additionally, 1,286 post-contrast abdominal CT images negative for SMAO were added to the training dataset. The model was trained using the yolo-v3 bounding box framework with a single output label for SMAO. A training/validation split of 90/10 was used, and the trained model was run on a test set containing SMAO and non-SMAO studies. The model was incorporated into our prospective data pipeline and run on incoming data, comparing the model result to the NLP result for a two-week period.

Results

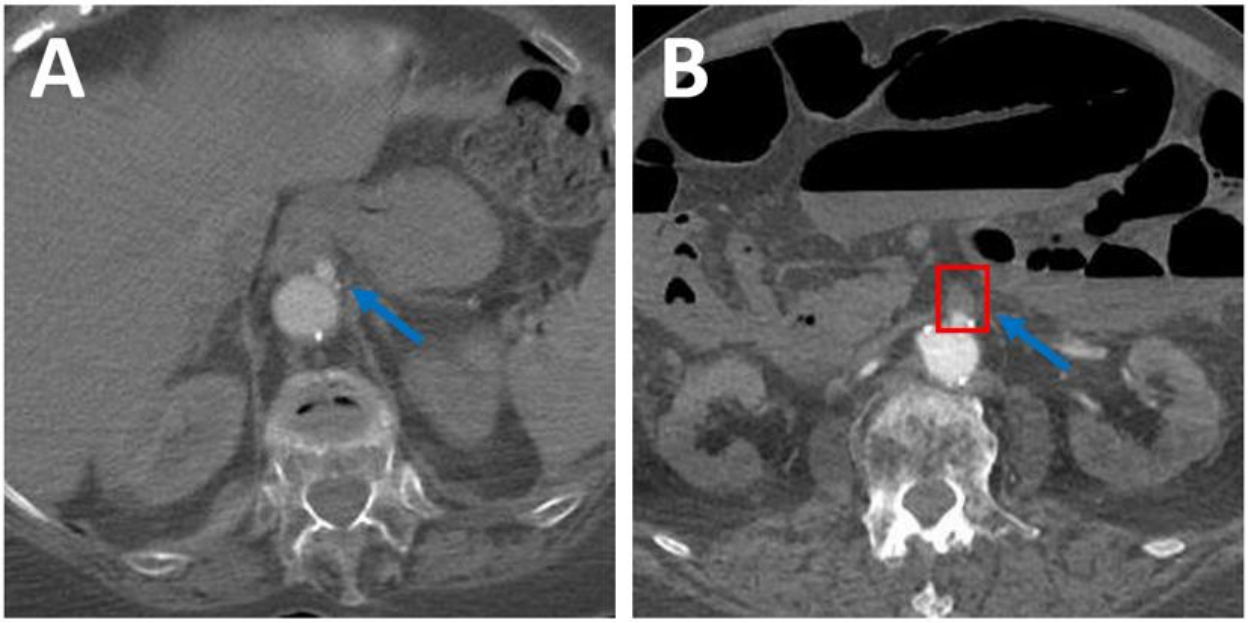
The best validation mean average precision (mAP) achieved during training was 0.616. The test set AUC was 0.936. For prospective data, 21,326 post-contrast abdominal CT studies passed through our system over a two-week period with a sensitivity and specificity of 50.0% and 99.4%,

respectively. As a relatively rare condition, only 8 SMAO cases came through during this time, of which 4 of them were identified. Many of the false positives contained atherosclerosis or partial occlusions, which were considered negative for the purposes of this study but may also be important clinically.

Conclusion

A machine learning model was trained that identifies SMAO in the clinical setting with high specificity and reasonable sensitivity. This model can be incorporated into a clinical workflow to avoid missed diagnoses of this critical condition.

Figure(s)



Keywords

Artificial Intelligence; Clinical Workflow & Productivity; Emerging Technologies; Imaging Research; Provider Experience; Quality Improvement & Quality Assurance