

DEEP LEARNING BASED GLAND DETECTION IN BARRETT'S ESOPHAGUS USING OPTICAL COHERENCE TOMOGRAPHY

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Doi: https://doi.org/10.34107/YFMV730994

ABSTRACT

Optical coherence tomography (OCT) is an advanced imaging modality to detect Barrett's esophagus (BE) dysplasia, providing widefield, cross-sectional imaging and microscopic resolution. BE dysplasia is characterized under OCT by the presence and number of glandular structures with atypical morphology. Accurate detection and interpretation of BE glands under OCT is essential to detect dysplastic lesions. Object Detection using deep learning has the potential to identify glands from OCT images. In this study, a deep learning object detection model which can identify the presence of glands in BE tissue under OCT is proposed. The YOLOv4 object detector was trained on a custom BE dataset of 30 patients with confirmed BE who underwent OCT imaging, of which 222 OCT images included at least one gland. Our model identified glands with a high average precision of 88.79% on the test dataset. We showed that the developed model is robust to rotation, brightness, and blur in images. We have implemented an object detection model to identify glands from OCT images with promising results accurately. This model has the potential to improve the diagnosis and surveillance of BE by eliminating human error and missed dysplastic lesions adaptable for capsule endoscopy applications.

Keywords: Barrett's esophagus, Optical coherence tomography, identification of glands, Object detection, You Only Look Once (YOLO).

INTRODUCTION

Barrett's esophagus (BE) is a pre-malignant condition that arises as a consequence of chronic gastroesophageal reflux leading to the replacement of normal stratified squamous epithelium (SE) of the distal esophagus by columnar mucosa containing goblet cells [1]. Esophagogastroduodenoscopy (EGD) using a systematic biopsy protocol is the gold standard for screening and surveillance of BE. The risk of progression of BE is estimated by the highest degree of dysplasia identified on endoscopic biopsies. Mucosal abnormalities associated with BE dysplasia can be subtle and sometimes missed under routine surveillance due to sampling error [2]. Advanced imaging modalities such as optical coherence tomography (OCT) can be used to enhance the detection of dysplasia during BE surveillance [3]. Endoscopic OCT systems use principles of interferometry to generate cross-sectional images of the BE epithelium at microscopic level resolution. Barrett's epithelium contains glands that are readily identified under OCT as hyporeflective structures. Features of BE dysplasia under OCT include the presence and number of glands with atypical morphology [4]. The aim of this study was to develop a deep learning model to aid in the identification and characterization of BE glands under OCT.