Ultraviolet autofluorescence microscopy provides real-time histopathology for esophageal disease

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Disease progression from dysplasia to cancer is currently invisible to the endoscopist using traditional methods. Using a plurality of experimental arrangements, we explore the potential of autofluorescence (AF) microscopy for in vivo imaging of esophageal disease. We aim to develop a method that provides real-time histopathology (visualization of tissue microstructures) without the use of contrast agents or tissue preparation. IRB-approved human esophageal biopsy specimens were collected and individually imaged ex vivo under various excitation conditions. Three experimental systems were used: a prototype hyperspectral microscope, an experimental microendoscopy probe developed by Olympus, and a rototype fiber conduit system. After imaging, biopsies were placed in formalin for histopathological evaluation.

Results indicate that short propagation depth under UV excitation allows imaging of cellular morphology and epithelial microstructure organization under wide field illumination without application of a sectioning technique. Cell junctions and nuclei were visible in squamous mucosa, goblet cells may be represented as darker structures in Barrett's esophagus, adenocarcinoma demonstrated a disorganized villiform pattern of abnormal epithelium. Real-time imaging of microscopic changes in tissue structure is critical for early disease diagnosis. Additionally, attaining diagnostic information in vivo can improve effectiveness of treatment. Our results suggest that adaptation of this technology into an endoscope probe for real-time in vivo imaging may provide a powerful tool for the detection and staging of esophageal disease and potentially other epithelial cancers. Preliminary studies suggest that imaging can be achieved with sufficiently low UV excitation doses using a single laser pulse to avoid motion artifacts.