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Hypoxia imaging endoscopy equipped with laser light source

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Backgrounds: Recent endoscopy has evolved into image-enhanced endoscopy (IEE) such as Narrow Band Imaging and Blue Laser Imaging. IEE focused on increasing abnormal micro vessels in the surface of early cancers. It is difficult to recognize biological change, function and metabolism in cancer by observing the morphological features of the micro vessels. In contrast, hypoxia is one of the functional characteristics in cancer with strong association to the biological features. Therefore, hypoxia imaging was innovated to visualize directly the biological and functional changes in cancer.

Aim: To evaluate the visualization of human early cancers in hypoxia imaging endoscopy prospectively.

Methods: In endoscopic equipment, we utilized a difference of absorption between oxy- and deoxy-hemoglobin in visible light wavelength. The signals converted from laser light were calculated in oxygen saturation (StO₂) by processor. Hypoxia imaging was obtained in real-time displaying two types of StO₂ images. In the first in human clinical trial, patients who had been confirmed to have pharyngeal, esophageal, gastric or colorectal neoplasia by previous endoscopy were enrolled. To compare histologic findings to hypoxia imaging, all patients received endoscopic resection immediately after conventional and hypoxia imaging endoscopy. We determined the corresponding areas of neoplasia and non-neoplasia in the endoscopic images and obtained StO₂ levels from the StO₂ map.

Results: Forty patients with neoplastic lesions in the pharynx, esophagus, stomach and colorectum were analyzed. The hypoxic area was completely corresponded to the portion of early cancer. Furthermore, 8 colorectal adenomas with histological low-grade atypia were also detected as hypoxia ranging from 3 to 10 mm in diameter. All esophageal cancers including 2 Barrett's cancers were detected in hypoxia images. Median StO₂ differences between neoplastic and non-neoplastic areas in the pharynx, esophagus, stomach and colorectum were -15.4%, -14.5%, -5.1% and -21.5% respectively. Furthermore, sensitivity of neoplasia defined as the proportion having correctly detected neoplasia, in the pharynx, esophagus, stomach and colorectum was 67%, 100%, 33% and 86% respectively.

Conclusions: Hypoxia imaging with the laser endoscope enables us to visualize spatial and temporal information of hypoxic conditions in human tumors. Hypoxia imaging illustrates a novel aspect of cancer biology as a potential biomarker and can be widely utilized in cancer diagnosis.

Biography

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