Confocal microscopy: is there a future in view of current results?

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Goal of gastrointestinal endoscopy is mainly the detection and diagnosis of premalignant and malignant lesions. Recently, a fluorescence confocal endomicroscope system has been developed that allows subsurface, microscopic imaging of living cells in colonic tissue in vivo.

The components of the confocal laser colonoscope are based on integration of a confocal laser microscope in the distal tip of a conventional video colonoscope, which enables confocal microscopy in addition to standard video endoscopy. The diameters of the distal tip and the insertion tube were 13.4 mm and 12.8 mm, respectively. The distal tip contained an air and water jet nozzle, two light guides, an auxiliary water jet channel (used for topical application of the contrast agent) and a 2.8 mm working channel. Actuation of imaging plane depth is controlled using two additional buttons on the handpiece.

During laser endoscopy an argon ion laser delivered an excitation wavelength of 488 nm and the maximum laser power output was ≤ 1mW at the surface of the tissue. Confocal image data were collected at a scan rate of 0.8 frames/sec (1024 × 512 pixels) or 1.6 frames/sec (1024 × 1024 pixels). The optical slice thickness is 7 µm with a lateral resolution of 0.7 µm. The range of the z-axis is 0-200 µm below the surface layer. Confocal images can be generated simultaneously with endoscopic images.

In the first study concerning screening of colorectal cancer 42 patients were examined with this new developed endoscope [1]. 13020 confocal images from 346 different locations (256 inconspicuous areas ; 134 circumscribed lesions) were compared with histologic data from 1038 biopsies. By the use of in vivo fluorescence confocal endomicroscopy, different cellular structures, capillaries and connective tissue limited to the mucosal layer could be identified. Findings by confocal laser endoscopy accurately predicted histologic findings in the vast majority of cases. Neoplastic changes could be predicted with high accuracy (sensitivity 97.4 %; specificity; 99.4 %; accuracy: 99.2 %).

Also in patients with ulcerative colitis confocal endomicroscopy can be used to facilitate surveillance. In the second study 41 patients with ulcerative colitis underwent colonoscopy with methylene-blue aided chromoendoscopy in addition to endomicroscopy [2]. During withdrawal of the endoscope, methylene blue-aided panchromoendoscopy was performed to unmask circumscribed lesions. Standardized locations (every 10 cm) and every circumscribed lesion were examined using the confocal microscope, and afterwards biopsies were taken. Confocal images were graded according to cellular and vascular changes and were correlated with conventional histology in a prospective and blinded fashion. The presence of neoplastic changes (sensitivity: 94.4 %; specificity 95,6 %; accuracy 99,3 %) and inflammation could be predicted with high accuracy.

Future indications for confocal endomicroscopy are in vivo diagnosis of Helicobacter pylori as well as the diagnosis of Barrett's esophagus and associated neoplastic changes.

In conclusion, in vivo fluorescence confocal endomicroscopy is a newly developed diagnostic tool, which allows in vivo microscopic analysis of living cells during colonoscopy thereby enabling virtual histology. The diagnostic yield is comparable to histology after biopsy in the majority of patients. These newly discovered diagnostic possibilities are of crucial importance in clinical practice and may lead to an optimized rapid diagnosis of neoplastic changes during ongoing colonoscopy.

REFERENCES

1. R. Kiesslich et al. Confocal laser endoscopy for diagnosing intraepithelial neoplasias and colorectal cancer in vivo. Gastroenterology 2004; in press.
2. R. Kiesslich et al. In vivo fluorescence confocal laser colonoscopy for prediction of neoplasia in patients with ulcerative colitis. DDW 2004; oral presentation Gastrointest Endosc 2004; 59; AB97.

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