Optical coherence tomography catheter for cardiac tissue imaging and characterization

Published date: Oct. 13, 2016

Technology description

Summary

Catheter-based cardiac surgery has become routine in standard clinical practice, allowing clinicians to probe the interior of the heart without an intensive surgical procedure. Although electrical mapping and force-based catheters have been developed for cardiac applications, the ability to extract structural and functional information from the targeted tissue remains limited. Optical coherence tomography (OCT) is an established imaging modality that so far has largely been used for high-resolution imaging of the retina. The technology presented here is an OCT-based imaging catheter for structural analysis of cardiac tissue. By incorporating OCT technology into a clinical, catheter-based system, interventional cardiologists may be able to leverage the high resolution capabilities of OCT to perform screening for endomyocardial biopsy (EMB) or to monitor the formation of ablation lesions.

Optical imaging allows for guided biopsy and intraoperative ablation lesion assessment

Identifying the local composition and structure of cardiac tissue is of direct interest in EMB; unfortunately, current biopsy techniques result in poor yield due to the fact that locations are picked relatively randomly. A catheter-based OCT imaging platform could be used to screen for areas of interest before the biopsy procedure. In particular, this technology is able to clearly identify collagen content, tissue type, edema, and scar within the myocardium. The ability to differentiate between different tissue compositions could also assist during cardiac ablation, where it is important to monitor the lesion formation. Current methods to monitor ablation are limited to electrical and force-based measurements, which may not accurately reflect lesion size and transmurality. This technology combines the high resolution of OCT technology with the flexibility of a catheter deployment system, allowing this platform to be easily integrated into modern interventional cardiology procedures.

A prototype of this technology has been constructed and studies are currently underway using ex vivo cardiac tissue.

Lead Inventors:

Publications

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Singh-Moon RP, Marboe CC, and Hendon CP. "A near-infrared spectroscopy integrated catheter for characterization of myocardial tissues: preliminary demonstrations to radiofrequency ablation therapy for atrial fibrillation". Biomedical Optics Express. 2015; 6(7): 2494-511.

Yao X, Gan Y, Marboe CC, and Hendon CP. "Myocardial imaging using ultrahigh-resolution spectral domain optical coherence tomography". Journal of Biomedical Optics. 2016; 21(6): 061006.

Gan Y, Tsay D, Amir SB, Marboe CC, and Hendon CP. "Automated classification of optical coherence tomography images of human atrial tissue". Journal of Biomedical Optics. 2016; 21(10): 101407.

Application area

Screening technique for endomyocardial biopsy

Monitoring of lesion formation during cardiac ablation

Cather-based OCT imaging system

OCT-guided surgical procedures

Minimally-invasive tissue characterization

Advantages

High-resolution optical imaging

In situ tissue characterization

Catheter-based deployment method

Real-time imaging capabilities

Institution

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