Optical Tomography May Aid 3D Cancer Diagnostics

Optical coherence tomography (OCT) is often described as an optical analog of ultrasound—instead of gathering images through backscattered sound, it analyzes backscattered light produced by a laser. Widely used in ophthalmology, OCT is demonstrating potential clinical advantages for 3-dimensional (3D) detection for an increasing number of cancer types.

"OCT has the advantage that it can image 1 or 2 millimeters below the surface with high resolution, noninvasively," says James Fujimoto, PhD, in whose Massachusetts Institute of Technology lab the technique was first invented 2 decades ago.

Fujimoto and colleagues recently reported an endoscopic OCT prototype that boosted imaging speed to 960 frames per second in rabbit colon and esophagus *in vivo* and *ex vivo* in human colon specimens (Biomed Opt Express 2011;2:2438–48). "Increased imaging speed is important; it allows broader coverage or improved resolution," says Fujimoto. In this application, "the concept is not that the technology is trying to diagnose the cancer *per se*, since excisional biopsies do that well," he notes. "Instead, it is coupling 3D OCT scanning across the sampling area with standard biopsies."

"OCT fills a role that's not being filled by any other diagnostic technology right now," says Andrew Rollins, PhD, of Case Western Reserve University. "With cancers of the epithelium, many of the tissues are accessible endoscopically. Using OCT, we can image these epithelial tissues through their whole thickness, and we can see the transformations as they start to become dysplastic, which aren't always easy to see using conventional tools."

That's important for treatments such as ablation for Barrett's esophagus, where it's hard afterward to know the condition of tissue underneath the ablated surface, Rollins notes.

His group is building computer-aided diagnosis programs that aim to make OCT imaging analysis faster (potentially aiding some real-time diagnoses) as well as more efficient and less prone to variability between observers.

Another recent study demonstrated success in distinguishing low-risk and high-risk pancreatic cysts *ex vivo* in human specimens (Biomed Opt Express 2011;2:2372–82). Using standard ultrasound techniques, it's hard to differentiate between benign and malignant cysts, and biopsies guided by ultrasound only agree with histology about two thirds of the time, comments Nicusor Iftimia, PhD, of Physical Sciences Inc., first author on the paper.

"Potentially, OCT could be a tool that complements the biopsies and offers better clues as to whether a cyst is benign or malignant," Ifitimia says. Clinical studies are under way at the Massachusetts General Hospital to test this approach *in vivo*.

Cancer Discovery; Published OnlineFirst October 13, 2011; doi:10.1158/2159.820.CD-NB101311-OL-01