The nanomechanical signature of breast cancer

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The texture of breast cancer tissue differs from that of healthy tissue. Using a cutting-edge tissue diagnostic device, a group of researchers in Basel, Switzerland, has determined one key difference: cancerous tissue is a mix of stiff and soft zones, whereas healthy tissue has uniform stiffness. This new finding may one day help improve breast cancer diagnosis and therapy by providing a unique nanomechanical signature of tumor tissue properties that indicates the potential for the cancer to spread. The team will present its work at the 57th Annual Meeting of the Biophysical Society (BPS), held Feb. 2-6, 2013, in Philadelphia, Pa.

"It is slowly being recognized that a key to the cancer problem lies in the physical properties of the tumor tissue and that biomechanics plays a key role in cancer cell migration, invasion, and metastasis," explains Marija Plodinec of the University of Basel in Switzerland. However, contradictory opinions persist about tissue texture, and the information is hard to get at – cellular mechanics happen at the nanoscale, 1-100 millionths of a meter. This research may help resolve the controversy.

To determine stiffness, the team applied a nanoscale microscope tip to a breast tissue biopsy to make an indentation, then visualized and measured the indentation with an indentation-type atomic force microscope, which provides unprecedented spatial resolution. "The most significant outcome of our measurements is determining that in healthy tissue the stiffness of the sample is homogeneous," Plodinec says. "Benign tissue exhibits a larger variability and malignant tissue shows a unique, very heterogeneous profile with soft and stiff parts alternating."

A key aspect of their experiment is the adaptation of atomic force microscopy to rapidly collect and correlate nanoscale stiffness measurements across entire biopsy samples. They used a device called ARTIDIS ("Automated and Reliable Tissue Diagnostics"), invented by Plodinec and colleagues Marko Loparic and Roderick Lim. Partnering with industry, their next step is to develop ARTIDIS into an easy-to-use device for clinical application, hopefully within two years.

"A critical advantage of ARTIDIS technology, as we see it, is that it provides an estimate of tumor aggressiveness and metastatic spread based on the unique nanomechanical signature," Plodinec says. "This signature may have potential prognostic and predictive value as a marker for therapeutic applications."

More information: Presentation #1639-Pos, "The nanomechanical signature of breast cancer," will take place at 1:45 p.m. on Monday, Feb. 4, 2013, in the Pennsylvania Convention Center, Hall C. ABSTRACT: tinyurl.com/b2edbq6

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