

CONTENTS

Imaging Strategies: The Bigger Picture

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When doctors search for cancer inside the body using images from X-rays, radio waves, or echoes of bouncing sound, they are scanning for tumors they can see. But maybe in the future this same technology might help doctors spot tumors that can't yet be seen, by looking for their footprints in the surrounding tissue.

The idea holds so much promise that the National Cancer Institute sponsored a conference in 2006 devoted to the possibility of viewing the tumor microenvironment, focusing particularly on the potential for better imaging in breast and lung cancers.

“Only imaging techniques can simultaneously reveal spatial relationships and functional activity ... and potentially do so in vivo, non-invasively, over time,” the scientists from the meeting reported. Because the tumor microenvironment exists at the intersection of form and function, new imaging techniques have the potential to improve the detection of tumors, more quickly monitor the effects of therapy, and provide insight into cancer behavior. Studies of the tumor microenvironment might even improve diagnosis and screening by allowing doctors to more clearly detect the presence of cancer without need of a biopsy.

For example, says Michelle Martin, PhD, of Vanderbilt University Medical Center, “the vasculature within the tumor is very different from the vasculature in normal surrounding tissue.” Blood vessels in non-malignant tissue are orderly and sealed, but vessels surrounding tumors can grow in leaky, snarled tangles. While an MRI can already provide an image of a tumor's circulation, future improvements in the ability to see vessels might shorten the time and improve the safety of testing new drugs, because researchers wouldn't have to wait for patient symptoms to appear or disappear.

The appearance of blood vessels isn't the only thing that might one day change cancer imaging. Researchers are also working on ways to visibly detect changes in oxygen levels, the makeup and density of surrounding cells, and even changes in tissue mechanics. But challenges remain: One of the major changes in the tumor microenvironment involves the communication among cells, something that can't be readily seen. Neither can the complex interaction of the immune system around a tumor.

So for now, these approaches are mostly confined to animal studies that try to reveal the secrets shared between a tumor and its surroundings. “The hope is with the understanding of those interactions, we can begin to perturb them,” Martin says.

