New thermal-imaging technique may help victims of head and neck cancers

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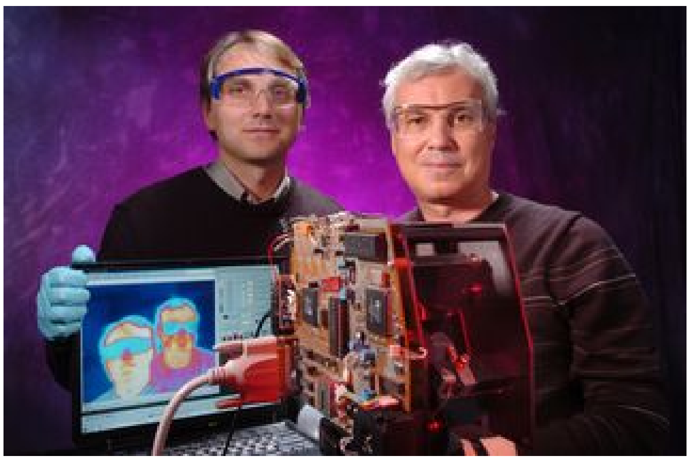

Argonne materials scientists Valentyn Novosad (left) and Volodymyr Yefremenko pose in front of their infrared camera. Cooler temperatures are represented on the screen as blues and pinks, while warmer temperatures are shown as yellow.

When University of Chicago head-and-neck cancer researcher Cindy Bajda felt a raised bump on the bottom of her mouth, she'd spent too much time around oral cancer patients to have any doubt as to her diagnosis.

"I knew what it was," she said. "I knew I had buccal cancer, and I knew what was likely to happen to me."

While buccal and other head-and-neck cancers are treatable and frequently curable, patients who undergo the necessary treatment regimen – a combination of radiation and chemotherapy – frequently develop unpleasant side effects. One of the most common and painful of these, oral mucositis, involves the inflammation and ulceration of the mucous membranes of the mouth and soft palate. These sores can make speaking, eating or even opening the mouth extraordinarily painful. If patients experience especially severe toxicity, they may temporarily lose the ability to taste or may even need to be fed through a tube.

Thanks to a recent scientific development, however, other patients with head-and-neck cancers may soon be able to anticipate how severe their reactions to treatment will be. The new development is an innovative, non-invasive imaging technique that uses the body's own thermal signature as an indicator of the degree to which patients may suffer the toxic effects of cancer therapy.

As part of the ongoing National Cancer Initiative, researchers at the U.S. Department of Energy's Argonne National Laboratory have teamed up with oncologists at the University of Chicago to use infrared imaging of the head and neck to predict which patients have the highest risk for severe mucositis. Patients who show local increases in temperature around the tumor site in the immediate wake of the initial round of treatment may be more likely to suffer later side effects, said Ezra Cohen, a University of Chicago oncologist who will head up the clinical side of the project.

Cohen, in collaboration with Valentyn Novosad, a principal investigator in Argonne's Materials Science Division (MSD), has already run a pilot study of six patient volunteers, which they parlayed into a successful grant proposal to the National Institutes of Health that will enable them to undertake a two-year study of 34 patients with head and neck cancers. Oncologists use radiation therapy as an aggressive, but crude, method for fighting cancer. Although the radiation beam is typically focused on the area that contains the tumor, it cannot tell the difference between healthy and malignant cells. As a result, normal tissues suffer collateral damage as tumors are zapped. "At this point," Cohen said, "we have no treatment that allows us to kill tumor cells without also damaging normal tissue. We accept the toxicity because it's a necessary part of the intended cure, and we know that it eventually gets better."

That was not much consolation to Bajda, who said that the familiarity she had bred with the disease by having studied it greatly helped to sustain her during the extended period where her mouth was so riddled with sores that she couldn't eat solid food, lost close to 50 pounds and was threatened with a feeding tube. "The chemotherapy was nothing compared to the mucositis; it was just so much more painful," she said. "Since there's nothing on the market that can alleviate the symptoms, just having the mental preparation is a huge advantage."

In order to detect possible toxicity, Novosad and Argonne physicist Volodymyr Yefremenko developed a prototype infrared camera that detects temperature gradations as small as one-twentieth of a degree Celsius. Typically, the tumor appears warmer than the surrounding tissue, but for some patients the infrared image taken after the first round of chemo- or radiation therapy shows a larger region of elevated temperature around the tumor site, indicating the beginning stages of inflammation. These patients, Cohen said, are the ones most likely to encounter problems with mucositis down the road, even if they are not yet symptomatic. Argonne scientists are developing a standardized approach to quantify changes in thermal signature of individual patients during the course of therapy.

At early points in their treatment, some past patients remained either uneducated or in denial as to the severity of probable side effects, according to Bajda. "I'd talk to some of our patients, and they'd look at me and tell me, 'this isn't going to happen to me.' And when it did happen to them they were the ones who suffered the most because they didn't prepare."

Without this technology, doctors would have no way of telling which patients had the greatest risk for developing mucositis, Cohen said. "Right now, I can only say to a patient that there is a small chance of severe toxicity, a good chance of moderate toxicity, and a small chance of very little toxicity. The problem has been that we've had no way to predict upfront who will suffer the most."

If doctors can use this technology to detect that a patient is likely to suffer a great deal of toxicity, it may enable them to tailor their treatment regimens more closely to patients' individual needs, according to Cohen. "If I knew that a patient would encounter severe toxicity, I might want to reduce the doses of chemotherapy a little bit. Or I might want to put in a feeding tube early on knowing that they're going to have trouble eating and drinking down the road. Or I might want to have very early consultations with physical therapists knowing that these are patients who are going to have trouble."

The project, Novosad said, is a part of larger synergistic R&D effort in MSD focused on advancing high sensitivity detector and imaging technologies for a broad spectrum of applications, including medical diagnostics, homeland security, materials science and astrophysics.

Source: Argonne National Laboratory