MedicalXpress

Tumors 'light up' with new, unique imaging system using scorpion venom protein and a laser

February 25 2014

Researchers at the Cedars-Sinai Maxine Dunitz Neurosurgical Institute and Department of Neurosurgery have developed a unique, compact, relatively inexpensive imaging device to "light up" malignant brain tumors and other cancers.

The experimental system consists of a special camera designed and developed at Cedars-Sinai and a new, targeted imaging agent based on a synthetic version of a small protein – a peptide – found in the venom of the deathstalker scorpion. The imaging agent, Tumor Paint BLZ-100, a product of Blaze Bioscience Inc., homes to brain tumor cells. When stimulated by a laser in the near-infrared part of the spectrum, it emits a glow that is invisible to the eye but can be captured by the camera.

Results of animal studies, published as the feature article in the February issue of *Neurosurgical Focus*, provide the basis for the launch of human clinical trials. The system would be used during surgery to determine if it enables neurosurgeons to remove more tumor and spare more healthy tissue.

Malignant brain tumors called gliomas are among the most lethal tumors, with patients typically surviving about 15 months after diagnosis. "We know that survival statistics increase if we can remove all of a tumor, but it is impossible to visualize with the naked eye where tumor stops and brain tissue starts, and current imaging systems don't provide a definitive

view," said Keith Black, MD, chair and professor of the Department of Neurosurgery, the article's senior author.

"Gliomas have tentacles that invade normal tissue and present big challenges for neurosurgeons: Taking out too much normal brain tissue can have catastrophic consequences, but stopping short of total removal gives remaining cancer cells a head start on growing back. That's why we have worked to develop imaging systems that will provide a clear distinction – during surgery – between diseased tissue and normal brain," said Black, director of the Maxine Dunitz Neurosurgical Institute, director of the Johnnie L. Cochran, Jr. Brain Tumor Center and the Ruth and Lawrence Harvey Chair in Neuroscience.

In studies in laboratory mice with implanted human brain tumors, the new device clearly delineated tumor tissue from normal brain tissue. Also, with near-infrared light's ability to penetrate deep into the tissue, the system identified tumors that had migrated away from the main tumor and would have evaded detection.

Pramod Butte, MBBS, PhD, research scientist and assistant professor in the Department of Neurosurgery, the article's first author, said the tumor-imaging process consists of two parts: deploying a fluorescent "dye" that sticks only to cancer cells, and using a laser and a special camera to make an invisible image visible.

To get the dye to the tumor, it is linked to a peptide called chlorotoxin, which, contrary to its name, is not toxic. It completely ignores normal tissue but seeks out and binds to a variety of malignant tumor cells. It first was derived from the venom of the yellow Israeli scorpion, also called the deathstalker. Article co-author Adam Mamelak, MD, professor of neurosurgery and director of functional neurosurgery, has studied the synthetic version of chlorotoxin and its tumor-targeting properties for more than a decade.

In this study, chlorotoxin was bonded to a molecule, indocyanine green, a near-infrared dye, a version of which already is approved by the Food and Drug Administration. The chlorotoxin-indocyanine green combination – Tumor Paint BLZ-100 – emits a glow when stimulated by near-infrared light.

"Injected intravenously, the chlorotoxin seeks out the brain tumor, carrying with it indocyanine green, which has been used in a variety of medical imaging applications. When we shine a near-infrared laser on the tissue, the tumor glows. But the glow emitted by the tumor is invisible to the human eye," said Butte, whose MBBS is India's equivalent of an MD. The camera device, designed in Butte's lab, solves this problem by capturing two images and combining them on a high-definition monitor.

"Other experimental systems we have seen – which use different tumor-targeting methods – are larger and bulkier because they consist of two cameras," Butte said. "Our single-camera device takes both near-infrared and white light images simultaneously. This is achieved by alternately strobing the laser and normal white lights at very high speeds. The eye just sees normal light, but the camera is capturing white light once, near-infrared light next, over and over. We then superimpose the two HD images. The image from the laser shows the tumor, and the image produced from white light shows the visible 'landscape' so we can see where the tumor is in context to what we actually can see."

The prototype is compact, but the authors said they are working to make the next generations even smaller, lighter and portable so the device will require very little space in operating room, allowing the neurosurgeon to focus on the operating microscope and give little attention on the imaging system. "We hope that eventually the camera can be transported in a small bag, but we are not sacrificing image quality for portability," Butte said. "In fact, most systems that use two cameras lose a lot of light.

But because of the special filters we use and the way we arrange them, we lose very little light. And from what we have seen and tested, our device provides about 10 times greater sensitivity and contrast than others."

In an editorial accompanying the journal article, David W. Roberts, MD, from the Section of Neurosurgery at the Geisel School of Medicine at Dartmouth College, said the Cedars-Sinai "paper presents a newer direction in which fluorescence-guided surgery may well be headed." He noted that the researchers overcame one of the limitations of near-infrared technology – that it is outside of the visible portion of the spectrum. "In this regard, Butte and colleagues have contributed to the field with their implementation of an optical system that is sensitive and efficient. They have characterized well its performance in phantom and animal models, demonstrating proof-of-concept and feasibility."

More information: *Neurosurgical Focus*, "Near-infrared imaging of brain tumors using the Tumor Paint BLZ-100 to achieve near-complete resection of brain tumors."

Provided by Cedars-Sinai Medical Center

Citation: Tumors 'light up' with new, unique imaging system using scorpion venom protein and a laser (2014, February 25) retrieved 5 May 2024 from https://medicalxpress.com/news/2014-02-tumors-unique-imaging-scorpion-venom.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.