NCI awards UC Davis $1.5 million to innovate robotic surgery for head and neck cancers

Researchers hope to improve precision of surgical techniques

The National Cancer Institute (NCI) has awarded UC Davis principal investigators Laura Marcu and Gregory Farwell $1.5 million to adapt UC Davis-developed biophotonic technology to a robotic surgical device in hopes of dramatically improving the precision of head and neck cancer surgery. This innovation aims to preserve a patient’s quality of life and improve survival rates.

Developed by Marcu, professor of biomedical engineering and neurological surgery, the multispectral scanning-time resolved fluorescence spectroscopy will attach to the da Vinci® surgical system, enabling the robot to scan and assess tissue. This will help the surgeon distinguish in real-time the difference between normal and cancerous tissue during head and neck cancer surgery.

“I want to help surgeons make better decisions about where to cut,” Marcu said. “Right now the da Vinci® system is very useful for accessing hard-to-reach tumors in the head and neck, but there’s no technology to provide real-time feedback of the tissue type. The only way to get information is to order a pathology report, which is not feasible when the surgeon has to rapidly decide where to cut.”

Survival rates for tumors in the back of the throat have improved significantly in recent years. The reason for this is that fewer of these are smoking-related cancers, which are harder to treat, than the increasingly common head and neck tumors related to the Human Papilloma Virus, or HPV.

Nonetheless, surgical removal of all of the cancer is critical to make sure that the tumor does not recur, and ensuring a good quality of life for the patient long-term.

“Some tumors are fairly subtle, and the eye is not refined enough to see them during surgery,” explained Farwell, professor and director of head and neck oncology and microvascular surgery.

Over the past decade, trans-oral robotic surgery is an increasingly common approach to treating squamous cell carcinoma of the head and neck, the sixth most common cancer worldwide.
“Robotic surgery is minimally invasive,” said Farwell, who routinely performs robotic-assisted surgeries at UC Davis Medical Center, the first hospital in Northern California to offer it. “It allows the surgeon to go through the mouth to remove tumors that previously would have required a more radical approach such as going through the lower jaw. This method translates into tremendous improvement in quality of life for the patient.”

Unlike surgery to remove cancer in other parts of the body such as the colon or breast, in which additional tissue safely can be removed as a precaution against tumor recurrence, surgery to remove cancers in the head and neck does not allow for such flexibility.

“If we treat patients radically by removing more tissue, patients have a lower quality of life,” said Farwell. Because oropharyngeal tumors are located in functional areas such as on the tongue and close to the voice box, a surgeon has to be extra careful when excising tissue to remove the cancer because removing too much can impair a critical function, such as a patient’s ability to speak.

“But if we undertreat and don’t cut enough, we risk not getting all of the cancer, and the tumors return,” Farwell added. “We’re trying to find a balance between under- and over-treating.”

Farwell said he hopes the adaptation of the robot to the state-of-the-art optical biopsy technology will be the key to addressing this critical challenge.

Working with Jonathan Sorger, director of medical research at Intuitive Surgical, the company that pioneered the da Vinci® surgical system, Marcu will integrate her fiber optic wand technology into one of the robot’s surgical arms. Farwell will apply the technology in squamous cell carcinoma patients to guide the removal of the tumor during surgery. The device will use laser light to excite molecules within tissues to “read” with pinpoint-accuracy the biochemical status of the tissue without the need to inject any contrast agents.

“It’s like adding senses to the robot,” said Marcu. “We will point the probe to different locations and have feedback within less than a second on the screen.”

If successful, the approach could dramatically improve the precision of surgical techniques significantly improving survival and quality of life for patients, the principal investigators said.

“It’ll make surgery faster, less challenging, and there will be significant advantages all the way around,” Farwell added.

Marcu anticipates that the modified da Vinci® technology will be ready for clinical evaluation in less than a year. If determined an invaluable diagnostic tool, the technology may change the way robotic surgery is conducted in a range of tumor surgeries including urologic, colorectal, gynecologic and thoracic cancers.

“This project is a great example of bioengineers, clinicians and industry partners working together to translate innovative biophotonic technologies to the operating room. I hope this project will really make a difference in patient care,” she added.

The research is funded with NCI grant No. 1 R01 CA187427-01.

**UC Davis Comprehensive Cancer Center**

UC Davis Comprehensive Cancer Center is the only National Cancer Institute-designated center serving the Central Valley and inland Northern California, a region of more than 6 million people. Its specialists provide compassionate, comprehensive care for more than 10,000 adults and children every year, and access to more than 150 clinical trials at any given time. Its innovative research program engages more than 280 scientists at UC Davis, Lawrence Livermore National Laboratory and Jackson Laboratory (JAX West), whose scientific partnerships advance discovery of new tools to diagnose and treat cancer. Through the Cancer Care Network, UC Davis collaborates with a number of hospitals and clinical centers throughout the Central Valley and Northern California regions to offer the latest cancer care. Its community-based outreach and education programs address disparities in cancer outcomes across diverse populations. For more information, visit cancer.ucdavis.edu.
NCI awards UC Davis $1.5 million to innovate robotic surgery for head and neck cancers