Robotic radiosurgery advances treatment of brain tumors

By Clinton A. Medbery III, MD

Primary brain cancer is among the most difficult cancers to treat. Decades of research have made significant strides in making new therapies available, but still no curative treatments exist. Among today’s most innovative, effective treatments is robotic radiosurgery.

I have applied robotic radiosurgery using the CyberKnife® robotic radiosurgery system to treat brain tumor patients for more than three years. Building on the benefits of traditional radiosurgery, robotic radiosurgery eliminates the need for a head frame. Instead, image guidance technology and computer-controlled robotics deliver radiation to the tumor with sub-millimeter accuracy.

Traditional therapy

Brain cancer has long been difficult to treat. The brain does not respond to chemotherapy due to a blood-barrier mechanism that keeps harmful substances from entering the brain. Standard radiation therapy, despite high doses delivered to the tumor, usually does not eliminate it.

In place of chemotherapy and radiation therapy, doctors turned to open surgery if the tumor was accessible. Even today, patients with large tumors or those who are highly symptomatic and can physically withstand surgery are still considered candidates for surgical resection. However, the procedure can carry significant risk to the patient and many tumors cannot be safely accessed with surgery.

Since the late 1980s, neurosurgeons and radiation oncologists in the U.S. have turned to radiosurgery as an alternative treatment option. The field of radiosurgery began with the introduction of the Gamma Knife.

Though an important advancement in the treatment of brain tumors, treatment with Gamma Knife requires a metal head frame to be bolted to the patient’s skull to prevent motion during treatment. In addition to the significant patient discomfort, the frame limits the tumors that can be treated.

Robotic radiosurgery

Robotic radiosurgery was conceived from the vision of creating the next generation in radiosurgery. Led today by the CyberKnife System, it incorporates image guidance technology and computer-controlled robotics to deliver radiation to the site of the tumor with sub-millimeter accuracy. Because the system is designed to continuously track, detect and correct for tumor and patient movement, no invasive head frame is needed.

The absence of the head frame contributes to many benefits over traditional radiosurgery in treating tumors in the brain. First, it allows for fractionation of treatment, which is crucial for navigation of radiosensitive tissue areas. Fractionated treatment also can yield better outcomes in some patients because it allows the delivery of lower amounts of radiation during any given session.

Second, the CyberKnife System’s robotic arm allows for unlimited beam positions, enabling physicians to target the tumor from any direction. The benefits of this feature are twofold: Physicians can better avoid critical structures, and they can treat tumors unreachable with traditional radio- and open surgery.

Third, robotic radiosurgery is more comfortable for the patient and requires no invasive set-up procedures. During treatment, which can last 30 to 90 minutes, the patient lies on the table wearing street clothes while the robotic arm moves around him according to the plan established by the care team.
Finally, because a head frame is not required, the CyberKnife can be used to treat patients not eligible for traditional radiosurgery due to unique circumstances, such as large craniums that do not fit into the frame.

Accurately, aggressively treating one of the most challenging cancers with minimal trauma and achieving results that are comparable to resection is a tremendous advancement. The next step is to promote greater access to this option.

St. Anthony's is the only hospital in Oklahoma City with a CyberKnife. To improve community access, our neurosurgeons and radiation oncologists participate in conferences with three other regional facilities to regularly review cases to determine the most beneficial treatment for each patient.

Continued awareness and advancement of robotic radiosurgery through efforts such as ours are critical for propelling effective treatment options for patients. While we continue to search for a curative treatment for brain tumors, robotic radiosurgery gives us a new frame of mind for treating today's patients.

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