Stereotactic Surgery Boosts Accuracy When Treating “Hidden” Brain Tumors

Using Star Wars-like technology, neurosurgeons have begun to win the battle against many childhood brain tumors that previously would have been difficult, if not impossible, to remove surgically.

Treatment results have improved with the evolution of computerized guidance systems that permit surgeons to locate tumors and follow the progress of surgery with unprecedented accuracy. The generic term for the technique is stereotactic surgery.

“Surgeons don’t have x-ray vision,” said Raymond Sawaya, M.D., chairman of neurosurgery at the University of Texas M.D. Anderson Cancer Center in Houston. “We don’t know exactly where the tumor is in the depths of the brain, once we get inside. This technology helps us accomplish more complete resection of the tumor.”

Speaking in Houston at the 2nd Japan-U.S. Symposium on Pediatric Cancer, Sawaya discussed the importance of complete resection to patient outcome and the technology that has improved surgery.

Stereotactic surgery relies on high-quality radiologic images obtained by means of computed tomography or magnetic resonance imaging. The images reveal the tumor location and depict the tumor and surrounding tissues in three dimensions. Reference points around the

A pediatric brain tumor before and after resection with stereotactic surgery.
tumor are selected and displayed on the images, which appear on a monitor.

All the information goes into a computer, which is connected to one of several types of devices. Older systems have a metal frame that encircles the patient's head. Newer systems have a movable arm that ends in a "wand" that a surgeon can move over the surface of the head to pinpoint the tumor and obtain precise information about tumor dimensions.

"The technology allows us to localize any point in space, whether it is in outer space or the inner space of the brain," said Sawaya. "We need about six [reference] points, which tell the computer about the position of the head. Once the computer has that information, we can move the articulated arm in any direction, and the computer will know where we are.

"By rotating the head, we can get different views of the lesion and surrounding areas. We maintain the 3-D orientation all the time," he said.

The technology has improved two major aspects of surgery for brain tumors in both children and adults. The first is accessibility. With the advanced guidance system, surgeons have a better chance to identify and remove small tumors, deep tumors, and tumors that arise in especially complex or sensitive areas of the brain.

"Even with very difficult tumors, we can often find ways to get to the tumor and resect it," said Sawaya.

Key Outcome

The second major advantage of stereotactic surgery relates to the completeness of tumor removal, which represents the key to outcome for many types of pediatric brain cancer. Sawaya briefly reviewed data on 400 brain operations. In 73% of cases, complete resection was possible and 7% of patients had subsequent neurologic problems. In the remaining 27% of cases, only incomplete resection was possible, and 17% of patients had neurologic problems.

By use of stereotactic technology, surgeons can monitor the progress of an operation, and they know when they have reached the bottom of a tumor. "Resectability means more than just the ability to reach a lesion," said Sawaya. "We can go through certain parts of the brain and not cause functional damage, so we need to define which areas [on the surgical route to the tumor] are of functional significance."

Brain tumor being pinpointed by stereotactic wand [same patient as on previous page].

Numerous studies have shown that maximal resection of brain tumors is associated with prolonged survival and better quality of life. The technology also has proven useful for operations on the spinal column.

Though an improvement over the cumbersome frame-type system, the wand used by Sawaya and colleagues is far from the last word in stereotactic surgery. In a further advance, the MRI images and computer system have been linked to a surgical microscope, allowing surgeons to keep both hands free of the devices. The wand requires periodic manual movement from one location to another.

Robotic surgical systems also are in various stages of development and evaluation. Robots, under direct control of surgeons, are especially useful when extreme precision is required.

"Some systems allow a surgeon to use a 'joystick' to guide the computer, microscope, and robot simultaneously," said Sawaya.

On the horizon, he foresees a big role for virtual reality technology. By use of special goggles or helmets, surgeons may be able to see inside the skull and visualize tumors and brain anatomy with even more precision than allowed by stereotactic systems. Virtual reality almost certainly will have a big role in surgical simulation and teaching surgical residents how to perform operations.

Other Advances

Advances in the treatment of pediatric brain tumors are not limited to the evolution of "gee-whiz" technology, as other speakers at the symposium demonstrated.

Encouraging results have come from an evaluation of a chemotherapy protocol for certain types of astrocytomas that are not completely resectable. Astrocytomas are the most common type of pediatric brain tumor, noted Joann Ater, M.D., chief of the pediatric neural tumor section at M.D. Anderson.

Investigators have treated 78 young children with the combination of carboplatin and vincristine. The mean age of the children is 3 years, and most have tumors that are located in the middle of the brain and around the hypothalamus.

Thus far, the treatment has resulted in four complete responses and 22 partial responses (greater than 50% tumor shrinkage). An additional 18 patients had minor responses (50% or less tumor shrinkage), and 29 have had disease stabilization.

"In tumors that are progressing, as these are, even stable disease may be
Cancer of the Corpus Uteri

ERT for Survivors of Endometrial Cancer? A New Trial Will Resolve Debate

A nationwide trial to resolve the controversy over the safety of estrogen replacement therapy for survivors of endometrial cancer will start enrolling patients this summer, researchers announced last week at the annual meeting of the American College of Obstetricians and Gynecologists in Las Vegas.

Prescribing ERT for patients with a history of endometrial cancer is controversial because about 85% of endometrial cancers are estrogen dependent. However, two small studies have suggested that ERT does not increase the risk of recurrence, challenging conventional wisdom and creating the current debate. In women with no history of endometrial cancer, hormone replacement is often prescribed after menopause to reduce the risk of cardiovascular disease and osteoporosis and to relieve menopausal symptoms.

"The outcome of this trial could help resolve a clinical dilemma facing thousands of endometrial cancer survivors and their physicians," said Robert C. Park, M.D., chair of the Gynecologic Oncology Group, which is organizing the trial. The GOG is one of 11 cooperative clinical trial groups sponsored by the National Cancer Institute.

About 35,000 new cases of endometrial cancer are diagnosed each year in the United States, making it the most common gynecologic cancer and the fourth most common cancer among women. The great majority of these tumors are discovered at an early stage, and more than 80% of patients pass the 5-year survival benchmark without a recurrence (see chart, left).

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Encouraging Results

An estimated 10% to 20% of primary brain tumors spread to the subarachnoid area, which has proven difficult to treat with conventional chemotherapy. Japanese investigators have been encouraged by initial results of a trial using the chemotherapy drug nimustine delivered via the spinal canal to treat subarachnoid tumor spread.

Eight of 12 pediatric patients have had complete disappearance of malignant cells from the cerebrospinal fluid after intrathecal infusion of nimustine. All seven patients with medulloblastoma had complete responses, and their average survival has exceeded 2 years, said Yukitaka Ushio, M.D., chairman of neurosurgery at Kumamoto University Medical School.

Cancer specialists at the Japanese medical school are contemplating a study of intrathecal chemotherapy as a means to prevent subarachnoid metastasis in patients at high risk.

— Charles Bankhead