INNOVATIONS
IN SPINE & BRAIN TREATMENT
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Tumors of brain, spine: Newer imaging modes make targeting and resection more successful

Preoperative functional MRI (fMRI) is found to be a highly useful tool in planning for surgical resection of brain tumors, reports a research team at Duke University Medical Center in Durham, N.C.

Writing in the September 2006 issue of *Radiology,* the Duke researchers also credited preoperative fMRI with opening the door to shorter surgical time, smaller incision sizes and safe removal of more tumor mass.

With regard to the shortening of surgery, the planning made possible by preoperative fMRI contributed to a reduction by as much as an hour in the time spent in the operating room, the team indicated.

Moreover, the ability to access the tumor through smaller incisions means patients can expect to spend fewer days recovering postoperatively in the hospital, the researchers added.

A transformation is occurring

As the Duke experience suggests, use of advanced imaging technologies is dramatically reshaping the conduct of brain tumor surgery.

For example, as pointed out in the April, 2006, issue of *Neurosurgical Focus* (the journal of the American Association of Neurological Surgeons), intraoperative MRI has the advantage of allowing repeated acquisition of images during surgery, enabling superior resection of tumor mass. Harnessed to a computer-guided neuronavigational system, intraoperative MRI would also make it a simple matter for the surgeon to overcome the clinical challenges imposed by the phenomenon of brain shift, the journal alludes.

Today's computer-aided neuronavigation systems separate the views of the brain into three planes – coronal, axial and sagittal – then merge those views with surface landmarks to create a three-dimensional map within a defined space of the brain.

The guidance afforded by these system is precise to within mere millimeters, showing the surgeon in real time exactly where his instrument is relative to the location of the targeted tumor. Thus can the surgeon leave intact the maximum area of function surrounding the tumor, explains the journal.

Old ways moving out of the way

This improved accuracy in tumor detection and neuronavigation leads to the possibility of performing resections on tumors located in places where in the past surgeons would dare not venture with their instruments.

Notably, it was not all that long ago when brain tumor surgery was guided by little more than an MR or CT image hung on a view box, from which the surgeon would manually take measurements and extrapolate those to the patient's head so as to establish a point of incision. Alas, in about 20% of cases, the incision point was off-mark enough to impede resection of the full tumor.

It should be clear, then, that static imaging of brain tumors is an outdated methodology.

The viability of endoscopic approaches

Another increasingly invaluable technology for accessing brain tumors is the endoscope.

"Primary endoscopic tumor biopsy and endoscopic tumor resection are becoming better characterized as procedures that can positively contribute toward the management of intraventricular brain tumors," contend the authors of a June 2005 analysis of endoscopic management of brain tumors published in *Neurosurgical Focus*. "Endoscopic neurosurgery for intraventricular brain tumors is a natural evolution of the technology..."

Further contributing to the appeal of endoscopic management of intraventricular masses is the fact that a number of tumors – particularly those occurring in children – ultimately do not require resorting to aggressive means by which resection may be accomplished, the journal says.

Still, the degree of success attained with endoscopic tumor removal depends on the composition of the mass targeted for resection, the journal cautions.

Overall, however, the periodical finds endoscopic resection "a very effective and safe method for tumor removal, with many of the advantages inherent in a minimally invasive technique."

Valid for spine tumor surgery, too

Our examination of the previously mentioned technologies has, to this point, centered on brain tumors. However, it should be noted that these systems are equally useful in surgical resection of spinal tumors.

Moreover, the usefulness of image guidance in spine tumor surgery cannot be overemphasized given that the primary objective is to maximize tumor volume resection while minimizing complications. Image guidance is particularly helpful in locating and avoiding critical structures as well as guiding the placement of instrumentation to stabilize the spine. Studies have demonstrated that patients in whom the spine is successfully stabilized after tumor resection achieve a dramatic reduction in preoperative pain (as much as 95%) and are far more likely to remain ambulatory.

The main surgical approaches to the treatment of metastatic spinal tumors are anterior, lateral, posterior or a combination of these three.

The location of the tumor relative to the spinal cord or cauda equina determines the approach. Involvement of the vertebral body (located in front of the spinal canal) necessitates an anterior approach for sufficient tumor debulking and spinal cord decompression. This is very useful in cervical spine as well as some lumbar spine cases.

A lateral approach is necessary for vertebral body tumors in both the thoracic and lumbar areas. Often critical structures such as the heart or great vessels that lay in front of the tumor require the surgeon to approach the spine from the "side" to avoid injury to these vascular structures. For example, the surgeon's ability to access retropulsed bone after pathologic fractures allows the problem of thoracic spinal kyphosis to be corrected via thoracotomy.

A posterior approach is most useful for tumors located "behind" the spinal canal. This usually involves a laminectomy or a costotransversectomy. Laminectomies – either unilateral or bilateral – permit removal of tumor and diseased spinal bone fragments from either the cervical, thoracic or lumbar areas. Costotransversectomy involves the resection of the lateral lamina and articulating rib head in the thoracic area, which allows access to tumors located posterior, lateral and potentially anterior to the spinal canal. Unfortunately, this technique affords decompression only and does not provide sufficient access for instrumented stabilization. However, thoracic disc herniations or tumors that do not destabilize the spine are ideally taken care of through this approach.

Tumors that surround the spinal canal 180 degrees or more require surgical planning of greater complexity. In these instances, the spinal cord often is encased in tumor accompanied by extensive bony destruction. Thus, using multiple approaches together makes it possible to better debulk tumor and stabilize the spine. For example, in the cervical spine, vertebral body tumors that involve the posterior elements require an anterior vertebral body resection with instrumentation as well as posterior laminectomy and posterolateral screws and rods.

Conclusions

Newer imaging technologies are providing better detection of brain and spine tumors.

Meanwhile, computer-aided navigation makes possible extremely accurate targeting for resection. These advances are resulting in more complete resection of tumors. At the same time, they are helping ensure the least disruption to the surrounding brain by leaving intact more of the healthy areas of function.

In addition to magnetic resonance imaging and other digital radiological modalities, endoscopy is available as a very good tool for the management of tumors – everything from tissue sampling to resection.

As a Mayo Clinic-trained neurosurgeon with years of experience involving these cases, I routinely employ all of these leading-edge technologies for brain and spine tumor surgical planning as well as for performance of minimally invasive resection. To find a comparable level of sophistication, one must look to the university setting. That is why more and more physicians in Milwaukee, Waukesha and neighboring Wisconsin communities are opting to refer to me their brain tumor and spine tumor patients.

It is for this and many other reasons that you, too, can refer to me with confidence for help in managing these challenging patients. In addition to being responsive and accessible to you, it is customary for me to keep you informed of your patients' progress, beginning with a detailed report sent to you after the initial consult and continuing with a letter following each successive visit. You can also expect a phone call from me after surgery to apprise you of the results and discuss any pertinent details. Additionally, I take the time to inform patients and answer all their questions in terms they can understand. Satisfied by the services and support I can provide, those of your patients treated for brain and/or spine tumors will return to you more willing than ever to continue entrusting their ongoing routine care to you.

For further information about brain tumor surgery, spine tumor surgery and my other neurology-specific surgical services, please call me at (262) 717-9850.

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