Neurological Surgery

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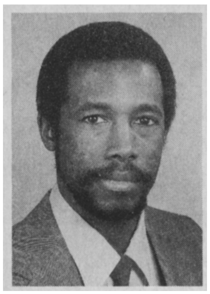
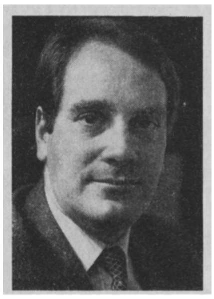


Dr Carson



Dr Brem

Neurosurgery has rapidly evolved into a very high-tech specialty. Neuroimaging modalities and neurophysiological monitoring techniques have eliminated a significant amount of postulation and have provided a sound basis for sophisticated preoperative planning.

A small nonprioritized sampling of some of these technological advances would include the following: (1) transcranial Doppler ultrasonography, used in the diagnosis and treatment of a variety of conditions where assessment of intracranial arterial blood flow is important, (2) single-photon emission computed tomography, useful in the evaluation of cerebral hemodynamics, cerebral perfusion, and brain tumor permeability, (3) positron emission tomography, which quantitates metabolic activity and finds new applications every year, and (4) three-dimensional computed tomography, which enhances preoperative planning in cases of craniofacial reconstruction, and recently, in addition to computer software that readily permits mixing of different tissue-density signals, has provided three-dimensional visualization of complex skull base lesions and their relationship to bone and large vessels.[1] Magnetic resonance imaging has had a tremendous impact on neurosurgery, and each year the capabilities of this modality increase. In addition to crisp anatomical detail, magnetic resonance imaging can now provide noninvasive imaging for atherosclerotic vascular disease as well as information about cerebral metabolism and cerebrospinal fluid flow dynamics. Clearly, these and many other new technologies will continue to exert a significant influence on the practice of neurosurgery as we enter the 1990s.

Surgery for epilepsy was performed even in ancient civilizations, although results were frequently less than gratifying. More recently, this surgical procedure has had mixed results. However, this is rapidly changing as sophisticated neurophysiological monitoring provides much better information about the absence or presence of specific seizure foci. Several medical centers have formed electromonitoring units to determine which seizure patients are surgical candidates and which surgical options should be employed. To optimize their effectiveness, these units require a multispecialty approach, with neuropsychologists and neurologists playing roles at least as important as that of the neurosurgeon.

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In addition to the obvious benefits derived from a team approach, surgery for epilepsy has also benefited from advances in surgical techniques that have rendered once formidable operations such as hemispherectomy relatively safe. The complications that once plagued such operations can now be rapidly and safely diagnosed and treated.

It has become increasingly clear that proper selection of surgical candidates has a major impact on surgical success. Relying on simple traditionally accepted anatomic localization of sensory and motor functions has led to many unfortunate neurological complications following cortical resections or lobectomies. Recently, Burchiel and colleagues[2] and Ojemann and colleagues[3] have demonstrated that our long-held beliefs about language localization need to be modified. Techniques such as open stimulation mapping, video electroencephalographic monitoring, and prolonged recordings from epidural and subdural arrays of surgically implanted electrodes are providing methods to avoid the anatomic pitfalls of the past. It is possible not only to determine the origin of seizure activity in many cases, but specific localization mapping of normal sensory and motor functions through the use of these modalities allows the neuroscientists to generate a detailed surgical blueprint, which permits aggressive yet relatively safe resection of brain tissue. The development of techniques such as magnetoencephalography, which detects magnetic fields created by neuronal discharges across the cranial surface, promises to provide even more information about epileptogenic foci in a completely noninvasive manner.[4]

Of note is the recent interest in using detachable balloons to treat clippable aneurysms, as well as lesions believed to be inoperable. Major advances in endovascular therapeutic modalities have occurred since detachable balloon embolization procedures for cerebral arteriovenous malformations and aneurysms were first described in the mid-1970s. These advances have rendered previously inoperable neurovascular lesions feasible for either endovascular therapy alone or a combination of endovascular therapy and surgery.[5] One obvious advantage in some of the endovascular techniques is the ability to carry out the procedure with the patient completely awake, which allows for continuous monitoring of neurological function. If any acute changes are noted, the balloon can be deflated, which permits the restoration of normal cerebral blood flow in the area. This is an area where the boundaries between some neuroradiology and neurosurgery specialties are becoming blurred. Many radiologists spend increasingly large amounts of time in the operating room to direct interventional neuroradiological procedures and provide intraoperative angiographic information, while many clinical activities of the neurosurgeon involve significant amounts of time in neuroradiology suites. Clearly this merging of knowledge and skills can only benefit the patient.

In addition to balloon embolization techniques, experience with glues, gels, and fibrin sealants has added to the armamentarium available to combat abnormal cerebrovascular channels and aneurysms.[6]

Refinements of surgical techniques and an improved understanding of the anatomy of complex areas such as the cavernous sinus make operative exposure of almost any area of the neuroaxis possible.[7,8] The availability of endovascular techniques makes it possible to appropriately modify blood flow through neurovascular lesions from the efferent or afferent side after these complex surgical exposures have been made. In many cases transvascular approaches to these areas is impossible due to convoluted anatomy, inadequate blood flow, technical inadequacies, etc, and surgery alone cannot obliterate the lesion without injury to important surrounding structures. By combining the two therapeutic modalities appropriately, significant progress has recently been made in the treatment of carotid-cavernous fistulas, stenosed or spastic vessels, dural fistulas, vertebrobasilar fistulas and aneurysms, and large, deep arteriovenous malformations.[9]

This year a national survey was completed on the incidence, treatment, and survival of patients with primary brain tumors.[10] The most common presenting symptom of patients with brain tumor was progressive neurological deficit (68%), most frequently motor weakness (45%). Headache was a presenting symptom in 54%, and seizures in only 26% of the patients. Ninety-five percent of patients were evaluated by computed tomographic scan as of 1985. For all brain tumor cases, 98% of patients underwent surgical intervention. Biopsy alone increased in frequency from 12.4% in 1980 to 15% in 1985. Subtotal resections were conducted in approximately 45% of cases and total resections in 40% of cases. Anesthetic complications occurred in 0.2% of the cases, postoperative hemorrhage in less than 5% of the cases, increased neurological deficit during the first 24 hours postoperatively in approximately 10% of the cases, and wound infection in less than 2% of the cases. Radiotherapy was administered to 52% of patients with a brain tumor (including 3% of patients with "benign" meningiomas). Brachytherapy was utilized in 1.9% of cases as of 1985. Surprisingly, chemotherapy was utilized in only 13.8% of all patients with the diagnosis of glioblastoma or anaplastic astrocytoma. Investigative protocol participation occurred in only 7.6% of eligible patients. Those who did participate had a 5-year survival rate of 12%, whereas those eligible but not participating had a 5-year survival rate of 4.5%. In patients with glioblastoma, the 5-year survival rate varied between 7.6% for patients with Karnofsky scores of 70 or greater compared with a 5-year survival rate of 3.2% for patients with lower scores. By contrast, patients with meningiomas had a 5-year survival rate of 91.3%. For patients with anaplastic astrocytoma, the 5-year survival rate was 18.2%, for astrocytoma, 32.5%, and for medulloblastoma, 60.4%.

The role of reoperation has been evaluated. The national survey previously cited[10] showed that 14% of patients with high-grade glioma, 44% of patients with ependymoma, and 43% of patients with oligodendroglioma underwent reoperation at the time of recurrence. Reoperation for patients with glioblastoma has been reported to extend life by an additional 36 weeks.[11,12]

There have been major efforts to improve the outlook for patients with brain tumors. These advances include the intraoperative use of lasers, ultrasonic aspirations, diagnostic ultrasound, and computed tomography–aided stereotactic biopsies and aspirations. Interstitial radiotherapy has produced promising results and is being evaluated in multi-institutional studies.[13] New chemotherapeutic agents, immunotherapeutic agents, biologic response modifiers, and new techniques such as the gamma knife, photoradiation, and hyperthermia are also being investigated.

This year saw the introduction of a new method of drug delivery to the brain.[14,15] A biocompatible, biodegradable polymer (polyanhydride) has been used to deliver chemotherapy to the brain. A Phase I study that involved 21 patients at five medical centers showed that these polymers were safe when implanted at the time of surgery. A prospective, placebo-controlled, randomized study is currently under way to determine if this method can effectively deliver high doses of chemotherapy and minimize systemic exposure. Such an approach opens the door for targeted therapy to specific locations in the brain.

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