Editorial

INTRACRANIAL SPACE OCCUPYING LESIONS: RECENT CONCEPTS AND TECHNIQUE MANAGEMENT

In this decade of brain, pediatric neuro-oncology is an important subspeciality of clinical neuroscience. Improved diagnostic techniques have contributed much to the management of central nervous system lesions. The treatment modalities include the use of biological response modifiers, monoclonal antibodies, safer and more effective radiotherapy, improved ability to surgically debulk and biopsy tumors and enhanced techniques to limit chemotherapy resistance. Invention of state of art instruments has transformed pediatric neurosurgery over the last two decades. CT scan, magnetic resonance imaging (MRI), intraoperative ultrasonography, operating microscope, ultrasonic surgical aspirator (CUSA), laser and intraoperative monitoring have contributed in making operations possible and safe.

Computed tomography (CT) is the most commonly ordered initial neuroimaging study. Because of its cost and less wide availability, MRI finds limited use although it is more sensitive than CT scan. CT and MRI are complementary. Areas of dense calcification which can be an important diagnostic clue can be missed with MRI alone. MRI is less specific than CT. At times neoplasms identified on CT have been missed by MRI. Use of non-ionic low-osmolality contrast media have improved safety(1). Recently introduced scanners allow scan times as short as 0.6 sec, thereby decreasing the *X*-ray dose. Three dimensional reconstruction of CT or MRI images can display in orientation and complexity, the components like vascular, tumor, skull, ventricular system either together or separately.

Magnetic resonance imaging has been used to evaluate tumors of CNS since 1982. T_1 weighted images provide anatomic detail whereas T_2 weighted images are more sensitive to pathology. The amount of signal that a tissue produces is primarily dependent on the number of mobile hydrogen protons, the speed with which the tissue is moving, T_1 relaxation time and T_2 relaxation time of the tissue. MRI is more helpful than computed tomography and use of MRI contrast agent gadolinium diethylenetriaminepentaacetic acid dimglumine (Gd-DTPA) has increased the specificity(2). The most important difficulty in MRI in infants and children is the long time required to complete imaging (one hour). Echo-planar imaging using shorter TE (echo time) have been designed for children so as to complete the study in short time(3). MR angiography is noninvasive procedure which can demonstrate the vascularity of tumor but not the origin of tumor vessel supplying a neoplasm.

Positron emission tomography (PET) and single-photon emission tomography (SPECT) of brain tumors can give presurgical estimation of tumor grade(4). PET can be used to differentiate tumor necrosis from recurrence noninvasively. Study of drug delivery, metabolic and physiologic responses of brain tumor to treatment provide the response of tumor and patient prognosis(5).

MRI in combination with gadolimium contrast administration has contributed a lot to the understanding of posterior fossa

and brain stem tumors. MRI of brain stem often distinguishes benign and operable lesions from inoperable, malignant lesions.

Peroperative ultrasonography can be performed both transdurally and subdurally in the posterior fossa tumors and thalamic tumors. Ultrasound allows the surgeon to ensure proper bony exposure before opening the dura. It can identify solid neoplasm and associated intratumoral and extratumoral cyst. Ultrasound can be useful in monitoring the ongoing tumor resection. Persistent abnormal signal warrants the surgeon to continue tumor removal whereas direct inspection may be unclear and may force the surgeon to stop the surgery prematurely.

Microscope by providing bright illumination, magnification and three dimentional picture has made the surgery of suprasellar, brain stem and pineal region possible and safe. Newer approaches have made it technically possible to extirpate the pineal region tumor with little morbidity and mortality and older treatment of preoperative radiation therapy has become obsolete(6). The microscope has greatly improved the visualization of the suprasellar anatomy in operation for craniopharyngioma and intraaxial lesions of brain stem. Intraoperative ultrasound and intraoperative evoked potentials provide the indices instead of the microscopic appearance of a tumor when to stop the operation. Post operative diabetes insipidus is quite easily controlled with nasal DDAVP taken twice daily.

Role of carbon dioxide laser is limited. The concentrated light source of laser is used to dissect or vaporize firm tumor tissue and it is carried out under operating microscope. Laser is most applicable to brain stem and thalamic tumors. Laser is mainly used at the end of resection to destroy the small foci of neoplastic tissue within the confines of exposure. Beneficial results of laser in thalamic tumors have been reported from this hospital(7).

The development of ultrasonic surgical aspirator (CUSA) has been a significant invention over the convention suction tips. The surgical tip of CUSA vibrates longitudinally and fragments the tissue, suspends the fragmented particles and sucks it. Cusa avoids movements of adjacent tissue thereby avoiding risk to adjacent vital structures. Cusa is an ideal instrument for debulking and removing the tissue rapidly. Cusa does not char the tissue so one can rely on the glial-tumor interface in deciding how far resection be carried out. Cusa is, therefore, instrument of choice in the surgery of brain stem, posterior fossa, pineal region, thalamic region and optic chiasma, *etc*. We have been using cusa for the last 11 years with beneficial results(8).

Intraoperative evoked potential monitoring provides physiologic guidance. Its most important applications are in the surgical management of suprasellar and brain stem tumors.

Imaging based stereotactic biopsy establish a tissue diagnosis and correlate histology with imaging defined abnormalities(9). Complications of stereotactic biopsy like hemorrhage and transient neurological deficit are very few. Computer reconstruction gives information of tumor volume in three dimension and it can be resected by stereotactic volumetric technique through a cyclindrically shaped retractor using a stereotactically directed and computer monitored laser from subcortical locations like thalamus(10). Computer assisted volumetric stereotactic surgery has the advantage over conventional surgery in that it maintains surgical orientation, disrupts as little important brain

tissue as possible and computer display images provide information about where the tumor boundaries lie in relation to surrounding brain tissue.

Improvements in imaging localization and better understanding of tumor biology have resulted in improvement in therapy for children with medulloblastoma, ependymoma, craniopharyngioma, pineal tumor and astrocytoma of deep seated structures(11-15). Brachytherapy (interstitial brain implants) and radiosurgery achieve relatively focal high dose radiation delivery that improves local tumor control. ^{192}Iridium of ^{125}Iodine are usually used for brachytherapy. Low dose-rate irradiation offered by brachytherapy is less affected by hypoxic conditions and therefore, is more likely to eradicate the resistant hypoxic cell fraction in malignant gliomas(16). Etou *et al.*(17) reported 10% five year survival rate in diencephalic astrocytoma by using low intensity interstitial brain implants.

Radiosurgery is a technique of delivering a large single dose of irradiation to a well demarcated target volume. Orthovoltage *X*-rays, proton beam or multiple 60 Co teletherapy sources or photon small (*X*-rays) arcs using linear accelerates have been used for selected CNS tumors. Gamma knife is a unit containing more than 200 independent 60 cobalt sources, each oriented toward a specific isocenter. Steiner(18) reported efficacy of gamma knife surgery in primary treatment of craniophrayngioma and pineal region tumor and complications are quite rare with this technique. Excellent results have been obtained by Souhami *et al.*(19) in recurrent or primary astrocytoma craniopharngioma and chordoma by using fractionated technique radio surgery using 630-750 cGy/fraction on alternate days to 3780-4450 cGy in 2 weeks.

Malignant brain tumors are often associated with central necrotic region harboring hypoxic and therefore, radiation resistant tumor cells. Cisplatin has been used as a radiosensitizer for hypoxic cells when used with irradiation(20).

Glial fibrillary acidic protein (GFAP) in histologic section with medulloblastoma had better survival rate of 82% compared with 30% in the GFAP negative group and results were not affected by tumor location, patient age or different treatment regimens(21). Improvements in surgery and radiotherapy have had a major impact on survival results and today 50% of children with all types of brain tumors may be expected to survive(22). Chemotherapy using cisplatin, CCNU and vincristine gives good disease free median survival in medullobastoma(23). Currently, most popular drug combination for recurrence of medulloblastoma is CCNU, prednisolone, procarbazine and vincristine.

Stereotactic biopsy from brain stem is preferred over open biopsy because of fear of damaging vital brain stem structures and possibility of brain stem swelling. Epstein and Wisoff(24) defined four categories of brain stem tumors, *i.e.,* diffuse, cystic, focal and cervicomedullary. Diffuse variety is most common and carries worst prognosis and these types can be differentiated on MRI. Dorsally exophytic brain-stem tumor that bulge into fourth ventricle benefit most from surgery. Hyperfractionated dose of 7800 cGy gives better results(25). Most common radiation induced late effects like dementia, endocrinopathies and leukoencephalopathy have been reduced by altering therapy, *i.e.,* by delaying radiotherapy and following the cases by serial MRI in low grade astrocytoma that have been totally resected(26).

Biologic response modifiers like beta-interferon are reported to have encouraging

responses in children with isolated lepto meningeal spread. The effectiveness of the beta-interferon was increased if given after radiation therapy(27). Children tend to tolerate higher doses of biologic response modifiers, raising the hope of greater utility of these drugs for pediatric patients. In combination with aggressive surgery, radiation and chemotherapy, these agents may be an additional armamentarium for the treatment of childhood brain tumors.

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