INTRODUCTION:

Each year approximately 210,000 people in the United States will be diagnosed with a primary or metastatic brain tumor. An estimated 63,000 of these cases are primary malignant and non-malignant tumors. The remaining cases are brain metastases (cancer that spreads from other parts of the body to the brain). There are over 600,000 people in the US living with a primary brain tumor and over 28,000 of these cases are among children under the age of 20. Metastatic brain tumors occur at some point in 20 to 40% of persons with cancer and are the most common type of brain tumor.

There are many different types of brain tumors. Because brain tumors are located at the control center for thought, emotion and movement, their effects on an individual's physical and cognitive abilities can be devastating. Prognosis, or expected outcome, is dependent on several factors including the type of tumor, location, response to treatment, an individual's age, and overall health status. An estimated 35% of adults living with a primary malignant brain or CNS tumor will live five years or longer. Brain tumors in children are different from those in adults and are often treated differently. Although over 72% percent of children with brain tumors will survive, they are often left with long-term side effects.

The most common CNS tumors are astrocytomas and glioblastomas, followed by meningiomas and a variety of other less common tumors. Metastatic brain tumors start in other organs, e.g., lung, breast or colon, and spread to the brain. In adults, these are more common than primary brain tumors. Both primary and metastatic brain tumors can readily spread through the brain or spinal cord, destroying and compressing normal brain tissue.

Unfortunately, brain tumors are not usually detected until they cause signs and symptoms as there are no widely recommended screening exams for early detection. Symptoms of a brain tumor can include headaches (recent, new, or more severe than usual), seizures (in a person who does not have a history of seizures), cognitive or personality changes, eye weakness, nausea or vomiting, speech disturbances, or memory loss. While these are the most common symptoms of a brain tumor, they can also indicate other medical problems. If symptoms suggest a CNS tumor, a neurological examination is performed to evaluate brain and spinal cord function. Abnormal examination results may be followed by imaging tests, e.g., computed tomography (CT) and magnetic resonance imaging (MRI). These tests may detect the presence of a tumor as well as the exact location of the tumor. Tissue from an abnormal area may be removed for a diagnosis. However, in rare instances, tumors may present within critical locations, precluding safe biopsy, forcing treatment decisions to be based on clinical presentation and imaging studies alone.
Surgery, radiation therapy and chemotherapy are the primary modalities used to treat CNS tumors, either alone or in combination. The first step in brain tumor treatment is usually surgical resection, with two primary goals: (1) removing as much of the tumor as possible while preserving neurological function and (2) establishing a histologic diagnosis. If the tumor cannot be completely removed, subtotal resection, (debulking) can increase the effectiveness of other treatments. Deep-seated tumors of the brain stem, e.g., pontine gliomas, are generally diagnosed and treated based on clinical and imaging evidence. Diagnosis by stereotactic biopsy is preferred and is useful for disease classification and therapeutic intervention.

Radiation therapy may be delivered following surgical resection, debulking or biopsy procedures. It may also be used to treat recurrences in patients whose initial treatment was surgery alone. The value of radiation therapy lies in its ability to cure some patients, and to prolong disease-free survival for others. Combined modality approaches that include chemotherapy may also contribute to prolonged disease-free survival in pediatric patients with medulloblastoma, germ cell tumors and gliomas.

**GOAL OF THE GUIDELINE:**

The goal of these guidelines is to delineate appropriate indications for the employment of radiation therapy in the treatment of CNS cancer, and to define suitable methods of delivery of radiation therapy for these indications.

**GENERAL CONSIDERATIONS:**

There are many different approaches in delivering radiation therapy to brain tumors, including fractionated radiation therapy, stereotactic fractionated radiotherapy, stereotactic radiosurgery, brachytherapy, and proton beam irradiation. Fractionated conformal beam irradiation is the most common approach. Clinical target volumes are determined by brain tumor imaging consisting of enhanced MRI, enhanced CT, MRI profusion, brain FDG-PET scanning, and other imaging modalities. An enhanced MRI provides a reasonably good delineation of brain tumors (or enhanced CT for those who cannot undergo MRI). MRI spectroscopy and brain FDG-PET is useful for differentiating tumor from radiation necrosis. Clinical target volumes are commonly defined using the T2-weighted MRI scan with the planning target volume defined as a clinical target volume plus margin. The dose and fractionation of radiation depends not only on the tumor type, but also in the curative/palliative setting.

**MEDICALLY NECESSARY INDICATIONS FOR RADIATION THERAPY FOR PRIMARY CNS NEOPLASMS:**

**Gliomas**

- Low Grade Tumors – Grade I or II
  - Post-operative/biopsy – 3D-CRT/IMRT (max 30 fx)
- Recurrence – Low Grade
  - 3D-CRT/IMRT – (max 30 fx)
Consider reirradiation on select cases. Dose on individual basis

- High Grade Tumors – Grade III or IV
  - Post-operative/biopsy – 3D-CRT/IMRT (max 33 fx)
- Recurrence – High Grade
  - 3D-CRT/IMRT – (max 30 fx)
  - Consider reirradiation on select cases. Dose on individual basis.

**Ependymoma – High (Anaplastic) or Low Grade**

- Brain and/or spine 3D-CRT/IMRT(max 33 fx)

**Meningiomas**

- Low Grade and High Grade
  - 3D-CRT/IMRT (max 33 fx)
  - SRS/SBRT (max 5 fx)

**CNS Lymphoma**

- Complete response to chemotherapy – 3D-CRT (max 20 fx)
- Less than complete response to chemotherapy
  - Whole Brain – 3D-CRT (max 20 fx) with or without Limited field boost – 3D-CRT/IMRT (max 25 fx)

**Medulloblastoma/Supratentorial PNET (adult)**

- Craniospinal radiation with brain primary site boost – 3D-CRT/IMRT (max 31 fx total)

**Primary Spinal Cord**

- 3D-CRT/IMRT (max 28 fx)
- Tumor below conus medullaris 3D-CRT/IMRT (max 33 fx)
- SRS/SBRT – (max 5 fx)

**MEDICALLY NECESSARY INDICATIONS FOR RADIATION THERAPY FOR PATIENTS WITH METASTATIC BRAIN TUMORS**

Treatment of brain metastases are common, occurring in excess of one-third of all cancer patients and can occur months to years after treatment. Historically, a diagnosis of brain metastasis carried with it a poor prognosis. However, newer treatment techniques have allowed patients to live longer. Treatment is typically palliative in nature. In some patients, however, aggressive treatment with surgery, chemotherapy, or stereotactic brain radiosurgery results in prolongation of life. Radiation therapy in the management of brain metastasis includes whole brain irradiation, partial irradiation, and stereotactic brain radiosurgery. Prognosis varies dependent on the primary disease site, age, number of metastatic lesions, and time interval from initial treatment of the primary site.
Approximately 150,000 people will be diagnosed with brain metastasis per year in the United States. Most cancers, however, have the ability to spread to the brain, with the most common cancers being lung, breast, and melanoma.

**Metastatic Brain Tumors**
- Favorable Risk (i.e., 1 to 3 metastases, Stable systemic disease or New Diagnosis, pathologically confirmed diagnosis, no resection)
  - WBRT 2D/3D-CRT – 20-40 Gy (max 20 fx)
  - WBRT 2D/3D-CRT + 3D/IMRT boost
  - WBRT 2D/3D-CRT 20-45 Gy (max 20 fx)+ SRS boost (15-24 Gy)
  - SRS/SBRT alone for lesions ≤4cm, controlled systemic disease, EGOG less than 3 (max 5 fx)
- Unfavorable Risk (i.e., Poor systemic control, no role for chemotherapy, 4 or more metastases, pathologically confirmed diagnosis, no resection)
  - WBRT 2D/3D-CRT – 20-40 Gy (max 20 fx)
  - WBRT 2D/3D-CRT + SRS boost (15-24 Gy, max 1 fx)
  - WBRT 2D/3D-CRT + fractionated SRT boost (up to 5 fractions)

**Post Metastasis Resection**
- WBRT 20-40 Gy (20 fx max)
- WBRT + external beam boost

**Metastatic Spinal Tumors**
- 2D/3D-CRT – 15-40 Gy 20-37.5 Gy (max 15 fx)
- Dose/fraction dependent on tumor type and performance status
- Stereotactic radiotherapy/IMRT may be appropriate for re-treatment.

Unless otherwise indicated standard radiation fractionation consists of 1.8 Gy to 2.0 Gy per day

**TREATMENT OPTIONS REQUIRING ADDITIONAL CLINICAL REVIEW:**

**Intensity modulated radiation therapy (IMRT)**

If IMRT is not indicated as a standard treatment option, a peer review will be indicated. IMRT may be appropriate for limited circumstances in which radiation therapy is indicated and 3D conformal radiation therapy (3D-CRT) techniques cannot adequately deliver the radiation prescription without exceeding normal tissue radiation tolerance, the delivery is anticipated to contribute to potential late toxicity or tumor volume dose heterogeneity is such that unacceptable hot or cold spots are created.

Clinical rationale and documentation for performing IMRT rather than 2D or 3D-CRT treatment planning and delivery will need to:
• Demonstrate how 3D-CRT isodose planning cannot produce a satisfactory treatment plan (as stated above) via the use of patient specific dose volume histograms and isodose plans.

• Provide tissue constraints for both the target and affected critical structures.

**Stereotactic Radiosurgery (SRS) or Stereotactic Body Radiation Therapy (SBRT)**
If SRS or SBRT is not indicated as a medically necessary treatment option, a peer review will be required.

**Proton Beam Radiation Therapy**
Requests for Proton Beam Radiation Therapy require a peer review with a radiation oncologist. See Proton Beam Guideline.
REFERENCES


+survival+of+patients+who+receive+postoperative+radiation+therapy+for+supratentorial+low-grade+gliomas%3F++Int+J+Cancer.+96+(Suppl)%2C+71-78.


