Neurosurgical Management of Brain Tumors

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Acoustic Neuroma

- Treatment Options
  - Observation
  - Surgery
    - Sub Occipital Craniectomy
  - Radiosurgery
    - Gamma Knife
    - LINAC (Linear Accelerator)
MRI - Right Acoustic Neuroma

• 57 year old female
• ringing, hearing loss
• 3A: A- Antoni A region with dense, spindle-shaped cells.
• B- Antoni B region with more loosely associated, lower density cells.
• C- Higher magnification of Antoni A region showing verocay bodies (palisading nuclei in rows separated by cytoplasmic area).
Average Length of Stay
Gamma Knife vs. Craniotomy

Graph showing the comparison of Average Length of Stay between Craniotomy and Gamma Knife.
Indications

• Meningiomas
• Metastatic Tumors
• Trigeminal Neuralgia
• Pituitary Tumors
• Arteriovenous Malformations (AVM’s)
• Acoustic Neuromas
• CNS Malignancy
The Gamma Knife

- Remains the worldwide leader in Radiosurgery, No real competitor
- 300 Centers world wide
- Thousands of peer reviewed articles
- International Society - semi-annual meeting
- Excellent support group for
  - Research & Development
  - Equipment technical upgrades
  - Patient Care
  - Outcomes
Integral Part of Clinical Armamentarium

Alternative to Surgical Resection

Inoperable
Elderly, Unable to tolerate open surgery
Patient Preference

• Adjunctive Therapy
  • Residual Tumor or AVM
  • Recurrent Tumor
  • Boost Therapy
The Gamma Knife Treatment Team

• Neurosurgeon
• Radiation Oncologist
• Physicist
• Neuroradiologist
• Nurse Clinician
Case Review Committee
Guidelines

• **Acoustic Neuromas**
  • Diameter < 3.5cm

• **Pituitary Tumors**
  • Diameter <2.5cm
  • tumor progression

• **Meningioma**
  • diameter <3.5 cm
  • recurrent/residual tumor
  • tumor progression after RadRx
  • unacceptable surgical risk

• **AVM’s**
  • diameter <3cm
  • no proximal Aneurysm

• **Trigeminal Neuralgia**
  • typical pain pattern
  • CT/MRI within 3 yrs.
  • Refractory to medical Rx

• **Metastatic Tumors**
  • Diameter <3.5cm
  • Karnofsky >60
  • Survival >3months
Gamma Knife Procedure

• 1. Frame Placement
• 2. Imaging
• 3. Dose planning
• 4. Treatment Preparation
• 5. Treatment
Frame Placement

- 10 minutes
- Local anesthetic
- Positioning is important
2. Neuroimaging
3. **Dose Planning**

- MR/CT/Angio based
- unlimited no. of images
- real time correlation
Case History

• 31 Year Old Male
• Tinitis
• Hearing Loss
• Headaches
• FH- father had AN
Dose conformity with multiple isocenters

- **Single isocenter**
  - Tumor
  - Normal brain

- **Multiple isocenters**
  - 50% isodose lines
  - Tumor
Patient Positioning
Automatic Positioning System
5. Treatment

Precise
Reliable
Reproducible
Post Operative

- Out patient procedure
- Well tolerated
Demonstration Case

- 78 y/o female, vertigo, facial numbness
Case Example 1 - continued

Treatment Day

5 Weeks post-op
Case Example 2 - Metastatic Tumor

- 32 year old female
- 14 month history of breast cancer
- chemotherapy, radiation therapy
- new onset seizure
- neurologic exam - normal
• Pre Gamma Knife

◆ 12 weeks post treatment
Acoustic Neuroma
Brain metastasis to right temporal lobe

Before Treatment

2 Year Follow-up
Case Mix
Results

• Metastatic
  • >90% Tumor control
  • 1-4 lesions
  • equal to open surgery
  • less morbidity
  • should be used as boost to WBRT

• Meningiomas
  • >90% Tumor control
  • lower morbidity than open surgery

◆ Trigeminal Neuralgia
  ◆ 94% good to excellent pain relief

◆ Acoustic Neuroma
  ◆ 90-100% tumor control
  ◆ less morbidity
  ◆ significantly greater hearing preservation (50-70 %)

◆ AVM’s
  ◆ 60-90% obliteration
  ◆ volume dependent
Microsurgery
Patient Position-
Craniotomy for Acoustic Neuroma
Facial Nerve Paralysis

- Devastating complication
- Effects - speech, eating, swallowing
- Vision
- Cosmetically disfiguring
Glioblastoma Multiform

- Observation
- Surgery
  - Biopsy, Craniotomy
- Gamma Knife
  (Radiosurgery)
- Radiation Therapy
- Chemotherapy
Glioblastoma: Standard of Care

- Maximal safe surgical resection
- Radiation therapy
- Temozolomide (TMZ)
- Adjuvant TMZ for six (6) or more cycles

- Median survival 14 months (left untreated 3-4 months)
Glioblastoma Multiforme

- Most common form of Brain Tumor in Adults
- Most common in Frontal Lobe
- 14,000 per year
- less than 5% survival at 5 years

- Biologic features
  - Infiltrative Growth
  - Hypoxia
  - Angiogenesis

- WHO pathologic Classification includes
  - Mitosis and pleomorphism
  - Pseudo-palisading necrosis
  - Endothelial Proliferation
Chemotherapy
(for High Grade Gliomas)

• Temodar (Temozolomide)
  • Standard of Care
  • Phase III trials
    • Multicenter (85 institutions, 15 countries)
    • Clear objective end point - death
    • Prospective, randomized
    • 573 patients
    • Only 6% lacked definitive diagnosis
Kaplan - Meier overall survival
Risk Factors

• Hereditary - less than 5%

• Cell phones - numerous studies fail to show a relationship

• Male predominance

• No correlation with head trauma

• No correlation with diet, alcohol, tobacco, or environmental exposure
Prognostic factors

• Age under 45

• Surgically resectable location
  • This may be unrelated to the surgery itself and more related to the less eloquent location

• Both these are associated with increased survival
Immunotherapy

Tumor cells avoid detection by immune system, proliferate and acquire additional immunoevasive mechanisms

Brain is an “immune privileged” site, shielded from Igs and leukocytes

GB recruit bone marrow progenitor cells that support angiogenesis

Treatment- T cell mediated effector cells after priming the tumor through injection of antigen.
Gene Therapy

Based on insertion or modification of genes into a cell
Viral vectors used to deliver suicide genes, proapoptotic genes, cytokines

Antiangiogenic Therapy

GB overexpresses VEGF

Bevacizumab - humanized monoclonal antibody against VEGF
MRI with contrast

- Distant location
- Morphology Varies
Magnetic Resonance Spectroscopy

- Supplementary Information
- Evaluate the chemistry of the brain
- Used to evaluate recurrence from radiation
- Presence of tissue metabolites (creatine, choline, lactate)
- Unreliable for lesions less than 2 cm.
Gliadel Wafer

- Surgically placed wafers
- Highly toxic
- Expensive
- Limited Value
Neuronavigation

• Accurate
• Safe
• Efficient
Registration

• Frameless
Operative Planning
Accuracy Check

Check the accuracy of the navigation by touching anatomical landmarks or acquired intra-operative landmarks!
Lesion Removal
Hydrocephalus

- Enlarged ventricles
- Sub-ependymal flow
VENTRICULOSTOMY

• Bedside
• Or OR
• For Hydrocephalus
• For Trauma (Elevated Intracranial Pressure)
“Laser”

- Light
- Amplification by
- Stimulated
- Emission of
- Radiation
Dr. Vannevar Bush is head of the Office of Scientific Research and Development, which marshaled the scientific brains of the U.S. in the service of the war. As such, he has performed one of the greatest, though most secret, jobs of the war, so important in its scope as that of the Army chief of staff. Under his direction, 6,000 scientists worked on top secret projects as the development of radar and the atomic bomb.

In the July issue of the Atlantic Monthly Dr. Bush published an article in which he set a great task for men of science in the peace-time world. How has piled up a staggering body of knowledge—so staggering, in fact, that men of learning have great difficulty in finding and using the facts they want. It is the task of science, Dr. Bush says, to make this store of knowledge more available to all the human species. Says the Atlantic: "Like Emerson's famous address of 1837 on 'The American Scholar,' this paper by Dr. Bush calls for a new relationship between thinking man and the sum of our knowledge."

Life is indebted to the editors of the Atlantic Monthly for permission to bring a condensed version of this important article to its larger audience.

WHAT Dr. BUSH FORESEES

Cyclops Camera
Worn on forehead, it would photograph anything you see and want to record. Film would be developed at once by dry photography.

Multiplex
It could reduce Encyclopedia Brittanica to volume of matchbox. Material cost 3c. Thus a whole library could be kept in a desk.

Vocoder
A machine which could talk when talked to. But you might have to talk a special phonetic language to this mechanical stenographer.

Thinking Machine
A development of the mathematical calculator. Give it premises and it would pass out conclusions, all in accordance with logic.

Memex
An aid to memory. Like the brain, Memex would file material by association. Press a key and it would run through a 'trail' of facts.
A top U.S. scientist foresees a possible future world in which man-made machines will start to think.
Imaging

- MRI with contrast
- DWI
- Magnetic Resonance Spectroscopy