Surgical Approach to Brain Tumors: Past, Present & Future

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• **Evolution –**

• 1879 - William MacEwan removed parasagittal meningioma
  Surgery was based on Cerebral Localization

• X-rays - 1895 by Wilhelm Conrad Roentgen
  Surgery based on - Pneumo-Encephalography and Carotid Angiography

• CT Scan - 1972- Godfrey Hounsfield and William Cormack
  MRI - 1977 Raymond Vahan Damadian
Relevance of Anatomy

• Nerve cannot regenerate – precise approach must.

• Guides the surgical approach and intra op planning.

• One of the predictors of post operative outcome.
• **Features exclusive to brain** –

*• Neurons cannot regenerate*

• Concept of Malignant is different

• No Lymphatics in brain

• Intra Cranial Pressure
The approach

• Planning

• Medical Management

• Surgery

• Adjuvant Therapy
Surgical Planning - Considerations

• Patient Factors –

• Age

• KPS
Tumor Location

- Scalp to Skull base
- Supra tentorial / Infra tentorial
- Bone / Brain parenchyma / Intra ventricular
- Important for surgical & radiation planning
  as some will be easily resectable and others will be difficult to access
Surgical Considerations: Tumor Factors

- Tumor - Primary vs Metastatic
- Tumor Grade - Low / High
- Tumor Margins - Well defined / Infiltrating
- Compartment - Single / Multiple
- Morphology - Calcifying / necrotic
Surgical Considerations: Tumor factors

- Vascularity - Very vascular to avascular
- Functional Area - Eloquent Vs non eloquent area
- Prox. To CSF Path - Obstructive vs Non obstructive
- Potential to disseminate via CSF
Planning

- Counseling the patient/attendant about Diagnosis
- All Treatment options to be discussed
- Duration of surgery and expected blood loss
- Future plans of adjuvant treatment
- Cost of Treatment
- Life expectancy
Medical Management

• Treating the symptoms

  - Managing cerebral edema
    Steroids
    Mannitol

  - Seizure prophylaxis

  - Supportive treatment
Observation

• For Low grade Tumors  Pilocytic Astrocytoma

• Tumors with low growth potential, like occasional Meningioma in elderly, non functional pituitary adenoma without optic pathway compression, occasional Acoustic neuromas etc.

• Plan for periodic monitoring essential and patient to be counseled regarding treatment options.
Possibly Glioma - on Observation alone: Minimal enlargement over 17 years
Tumor Enlargement - Over 3 years
Surgery

• *The Goals* -

  - To obtain tissue for diagnosis

  - To tackle the disease burden by tumor decompression or if possible, by complete excision.
Surgery

• Open method - Craniotomy

• Closed or min. invasive- Endoscopy -
  Trans cranial
  Trans nasal
Craniotomy
Surgical aids

• Diathermy

• Suction Machine

• Microscope

• Endoscope

• CUSA
The Microscope

• Magnification – better delineation of anatomy

• Illumination at depth – helps prevent inadvertent injury to important structures

• Better resectability - complete excision
Neuro-Endoscopic surgery

- 1910, Victor de l'Espinasse, - First endoscopic operation

- February 6, 1923, William J. Mixter, a neurosurgeon, performed the first endoscopic ventriculostomy in a child with congenital obstructive hydrocephalus.
• Trans nasal Approach -
  Pituitary Tumors
  Craniopharyngioma
  Planum Meningioma
  Clival Tumors

• Trans-cranial Endoscopy
  Endoscopic Third Ventriculostomy
  Colloid Cyst
  Biopsy for Intra Ventricular lesions
The Change to Minimally Invasive Surgery

From Maximum exposure - minimum resection

to Minimum exposure - maximum resection
Advantages

Minimal Blood Loss
Less post operative pain
Faster Recovery
Shorter Hospital Stay

Caution: Learning curve like laproscopic surgery
Skullbase approaches

• Required mainly for Meningioma, Schwannomas, Chordomas, Glomus tumour

• Multi-compartmental skull base tumors
Skull Base
Awake Surgery for Tumors

- For Tumors close to eloquent area
- Concerned Motor function is continuously checked during surgery
- Patient needs to be motivated and co-operative to follow commands
• **After thought**

• Tumor left behind – surgical limitation or surgeon’s limitation

• If all clinical variables are same, will 2 pt respond similarly and show same outcome

• Post op response of brain
Advancements in Diagnostics

- **3T MRI** - Better and fast image acquisition
  - **fMRI** - maps the function of different area of brain surface
    - Better understanding of cerebral localization

- **Tractography** - Visualization of fiber tracts

- **CT Scans** - High speed multi slice
CE MRI showing LtParietal tumor

MR Tractography shows displaced nerve fibre around tumor
Advancements in Surgical Aids

• Stereotaxy
  - for deeper lesions
  - Lesion localization with 3D precision
    - Best for tumor biopsy
Intra operative MRI
Advancements in Anaesthesia and Critical Care

- Concept of Neuro-protection
- Long surgery possible
- Post op ventilation
- Supportive treatment
<table>
<thead>
<tr>
<th>Past</th>
<th>Present</th>
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</thead>
<tbody>
<tr>
<td>Limited Information</td>
<td>Better Informed</td>
</tr>
<tr>
<td>Large craniotomy</td>
<td>Optimally Invasive</td>
</tr>
<tr>
<td>Wide cortical Injury</td>
<td>Precise &amp; shortest path</td>
</tr>
<tr>
<td>Low Resectability</td>
<td>Maximum resection</td>
</tr>
<tr>
<td>Pure neurosurgeon’s realm</td>
<td>Multi-disciplinary</td>
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<tr>
<td>Outcome unpredictable</td>
<td>Mostly predictable</td>
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Has this all changed the outcome !!!

• Significantly improved outcome with very low morbidity, mortality, and predictable outcomes

• Better equipped and informed to tackle more challenging cases

• Better tumor resection has lead to either Cure or prolonged PFS in benign tumors
• Failures
• Glioma - Survival in 1970’s - 12 months
• 2015’ - 14 months
• Role of Surgery / Chemotherapy / RTh
• Local Failure
• Need to review the tumor biology and approach to tackle the menace
What’s the Patient’s view !!!
The Approach

• Our approach to patient’s complaints and it’s analysis
• Radiologist’s Approach
• Surgical Approach
• Pathologist’s approach
• Medical/Radiation Oncologist’s approach
• Nursing approach
• Physical and Psychological rehabilitation
• Approach to manage the complications / failure
• **What lies ahead?**

• Simulators for Training –

• LASER Surgery
LASER

Laser Interstitial Thermal Therapy

Unlike radiation, the tumor kill is immediate due to thermal effect.

Phase I trials – encouraging results

Treated tumor vol. 3-19cm²
Survival - 67-717 days
• **Gene therapy** -
  Molecular biology has important role
  Highly specific tumor cell killing by non replicating oncolytic viruses

• **Tumor Vaccine** –
• Mostly against high grade glioma
  Targeted against tumor antigens
  *Rindopepimut (CDX-110), DCVax-L* - Phase III trial
  *ICT-107* - completed phase II trial with encouraging results
Conclusions

• Better understanding of neuro-anatomy and tumor biology along with advancements in diagnostic and therapeutic adjuncts have significantly changed the patient outcome.

• More work is needed in management of malignant tumors.