Neurosurgical possibilities for brain and spinal tumours

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Introduction
- Terminology and Classification
- Symptoms
- Why operate? Why not operate?
- How to operate
- Clinical dilemmas

Imaging for Brain Tumors
- **Skull X-rays:**
  - Rarely necessary.
  - Useful in demonstrating calcification, erosion, or hyperostosis
- **CT:** Most widely used first diagnosis of brain tumors
  - Will detect >90% of tumors, but might miss:
    - Small Tumors (<0.5 cm)
    - Tumors Adjacent to bone (pituitary adenomas, clival tumors, and vestibular schwannomas)
    - Brain Stem Tumors
    - Low Grade Astrocytomas
  - More sensitive than MRI for detecting acute hemorrhage, calcification, and bony involvement
- **MRI:** "Gold standard"
  - More sensitive than CT scans
  - Can detect small tumors
  - Provides much greater anatomic detail
  - Especially useful for visualizing skull base, brain stem, & posterior fossa tumors

Infratentorial vs Supratentorial Tumors

Primary brain tumors
- Meningioma (35%)
- Glioma (30%)
  - Astrocytoma
  - Glioblastoma
  - Oligodendroglioma
  - Oligoastrocytoma
  - Ependymoma
- Pituitary Adenoma (13%)
  - Within skull
  - Beneath brain

Classification of Brain Tumours

**Gliomas** (adult practice)
- WHO Grade II - Low grade glioma
  - Progresses to high-grade glioma
- WHO Grade III
  - Astrocytoma (or Oligodendroglioma)
- **WHO IV - Glioblastoma Multiforme (GBM)**
  - Most common tumour in surgical practice
  - Usually adults, usually supratentorial
  - Median survival less than 1 year
Secondary brain tumors

- Non-brain origin = Cancer metastasis
  - Most common
  - 25-45% of cancer patients
    - Lung: >50% of all; most common in men
    - Breast: Most common in women
    - Melanoma: Highest propensity for brain
      - 50% of melanoma patients develop brain mets; Multiple
    - Renal Cell
    - Colorectal
  - Any primary can metastasize to the brain

Presentation (1)

1. Raised intracranial pressure
   - Headache
   - Vomiting
   - Drowsiness / coma / death
2. Focal neurological deficits
   - Usually (rapidly) progressive
3. Others
   - Epilepsy
   - Chest infection, dehydration

Presentation (2)

- Focal symptoms and signs
  → Site specific to location;

- Personality
- Cognition
- Expressive language
- Receptive language
- Weakness
- Incoordination
- Vision
- Incoordination
- Balance

Presentation (3)

- Generalized symptoms and signs
  → Elevated intracranial pressure

- Headaches (50%)
  - New or different
  - Worsening over time
  - Worse on awakening, improve after
    - Other symptoms
  - Seizures (30%)
  - Cognitive change (30%)

  - Personality change (25%)
  - Nausea/vomiting (15%)
  - Blurred vision/papilledema
  - Lethargy

Initial Management

Medical Treatment
- Fluid therapy
- Treatment of chest infection or UTI

Steroids:
- Reduce oedema
- Dramatic improvements in symptoms can occur
- No effect on survival
- Side effects
  - GI bleeds
  - Psychosis
  - Weight gain etc

Surgical Aims: Why Operate on?

1. Diagnosis
2. Symptom Control
3. Prolong Survival
Surgical Aims: Why Operate?

1. **Diagnosis**
   - Differential Diagnosis
     - Infection
       - abscess
       - tuberculoma
       - Cysticercosis
       - toxoplasmosis etc
     - De-myelinating lesion
     - Ischaemic stroke
     - Resolving ICH/contusion
     - Radiation necrosis
     - Giant aneurysm
   - Necessary for adjuvant therapy
   - Prognosis for patient and family

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**Case Study: Right Frontal Tumour**

- 53 year old healthy company director
- Recent confusion
- Diagnosis: intrinsic frontal tumour
- Advice: obtain MRI and neuro-oncology opinion

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**Case Study: Frontal Tumour** (cont.)

- Day 3 - Seen by local oncologist – told malignant brain tumour
- Day 5 - MRI
- Day 6 – Neurosurgery
  - Clinic
  - Surgery that evening

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**Case Study: Frontal Tumour** (cont.)

- Surgery: Aspiration of pus
- Diagnosis: **Cerebral abscess**
- Antibiotics started

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10 months later
- MRI: only minor changes
- Back at work

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2. **Symptom Control**
   - Current symptoms
   - Future symptoms
   - Reduction in side-effects of treatment
     - reduce steroid requirement
     - radiotherapy

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3. **Prolong Survival**
   - Prevent imminent death
     - eg cyst drainage
   - Longer term benefit
     - less clear
     - cure not possible
Surgery: Why NOT Operate?

- Benefits vs Risks
  - Multiple Risks including:
    - Neurological Disability – some areas more dangerous
    - Death
  - Surgery is potentially stressful, unpleasant and painful
  - Where possible let patient choose

Conservative Management

- May be appropriate when:
  - Severe neurological deficit
  - High anaesthetic risk
  - Little doubt of diagnosis
  - Patient does not want surgery

Surgery for GBM – Options and Aims

Biopsy

- Diagnosis Only

Craniotomy + Moderate Resection (De-bulking)

- Diagnosis
- Symptom Control
- Occasional short-term survival benefit

Radical resection (>90%)

- As above + possible long-term survival benefit

The main surgical controversy is de-bulking vs radical resection

Surgery – De-bulking vs Radical resection

- Radical Resection and/or multiple operations may prolong life
- Surgical cure is not possible
- Tumour recurrence even after hemi-spherectomy!
- Radical resection comes at cost of increased risk of disability

Surgery - Biopsy

- Surgical Approaches
  - Small craniotomy and open biopsy
  - Burr-hole biopsy (usually stereotactic)
- Usually chosen when de-bulking carries relatively high risks
- Relatively safe but still 0.6% mortality
Craniotomy for tumour

- As well as obtaining biopsy material, allows removal of tumour tissue
- Higher risk (Glioma Outcome Project 2003)
  - seizure 8%
  - deficit 10%
  - infection 1%
  - ICH 2%

Surgery - craniotomy

- R. parietal glioma
- Mayfield pins
- Incision marked

Surgery - craniotomy

- Patient draped
- Linear incision
- Skin clips

Surgery - craniotomy

- Hole drilled through skull
- Craniotome used to cut disc of bone

Surgery - craniotomy

- Skull flap lifted

Surgery - craniotomy

Dura

Brain and tumour
**Surgery - craniotomy**

- **Tumour cavity**

**Surgery - craniotomy**

- **Bone replaced and fixed**
- **Skin closed**

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**Surgical tools - Microscope**

- Improves visualization
  - Increased light
  - Increased magnification
- Improves surgeon comfort
  - Adjust scope angle, instead of bending/twisting

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**Surgery- neuronavigation**

- Based on “frameless” stereotactic principles
- Neuronavigation system
  - computer
  - image screen
  - camera

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**Surgery- neuronavigation**

- Prior to surgery MRI images are downloaded onto the system

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**Surgery- neuronavigation**

- In theatre the MR images are registered to the patients head
Surgery- neuronavigation

- Pointer will then relate to the pre-operative images

Surgical tools - Robotics

- Navigation systems with built in surgical assistant
  - Pre-plan surgical approach
  - Utilize the robot to align the instruments
- Minimally invasive
  - Single stitch incision
  - Maximizing precision

Surgical tools – Laser Ablation

- Minimally invasive
  - Single stitch incision
- Pass a probe into the tumor
  - Reduced risk to normal brain
- Utilize heat to destroy tumor cells

Awake Craniotomy

- May reduce the risk of causing injury to eloquent areas of the brain
  - Motor area
  - Speech area, etc
- Patient needs to be carefully selected

New Technologies

- Functional imaging
- Gliadel wafers
- 5-ALA fluoresces blue and is selectively taken up by tumour cells helping resection
- Molecular biology of tumours
  - More accurate prediction of outcome
  - ‘Tailored’ adjuvant therapy

Clinical Dilemmas - Case Study

- 33 yr old man
- Sudden loss of consciousness (GCS 9)
- Emergency Craniotomy and evacuation of haematoma + possible tumour
Clinical Dilemmas - Case Study

- Post op scan Day 3
- Slow recovery
- Family unable to understand severity of situation

Clinical Dilemmas - Case Study

- MRI 3 weeks post op
- Residual cognitive + speech problems
- Diagnosis – Gliosarcoma (rare form)

Clinical Dilemmas - Case Study

- 6 weeks seen at another centre
- Plan
  - further surgical resection within next 6 weeks
  - Radical Chemo/Radiotherapy

Clinical Dilemmas - Case Study

- Next day worsening GCS
- Re-presented to Queen’s A+E
- Dramatic increase in size of lesion
- Slight improvement with steroids
  - ‘semi-conscious’
  - unable to speak

Clinical Dilemmas - Case Study

Week 3

Week 6

What should we do next?

- Urgent surgery
- Urgent radiotherapy
- Palliative care
Clinical Dilemmas - Case Study

- Multi-disciplinary discussion: for palliative care
- Courtesy call to other unit who requested patient transfer
- After 24 hours patient deteriorated > emergency surgery
- Next week had second operation
- Very poor post-op recovery
- Not considered fit for adjuvant Rx
  - Life was prolonged but at cost of quality and dignity

Clinical Dilemmas - Case 2

- 47 year old healthy lady
- Headache, left sided weakness
- Some improvement on steroids
- On clexane for acute pulmonary embolus

Clinical Dilemmas - Case 2

- Surgery delayed because of PE
  - Very high risk (PE, bleeding)
- Day 13 - some tumour growth
- Day 14 - rapid craniotomy with very limited debulking
- Very well post-op

Clinical Dilemmas - Case 2

- Day 22 – seen in oncology clinic for discussion of adjuvant Rx
- Day 23 - became drowsy and confused
- Scan showed significant tumour growth + oedema

Clinical Dilemmas - Case Study

What should we do next?

- Urgent surgery
- Urgent radiotherapy
- Palliative care

Clinical Dilemmas - Case 2

- Day 23 – second operation with more aggressive debulking
- Only slight clinical improvement
Clinical Dilemmas - Case 2
Day 25 – Further clinical deterioration

Clinical Dilemmas - Case Study

What should we do next?
- Urgent surgery
- Urgent radiotherapy
- Palliative care

Clinical Dilemmas - Case 2

• Discussion with husband: not for surgery
• Later woke up enough to say she did not want further op
• Referred to Hospice
• Continued to improve and discharged! (steroids)

Spinal cord tumors

Surgical Aims: Why Operate on?
1. Diagnosis
2. Arrest neurological deficit
3. Prolong Survival
4. Pain
5. Deformity
6. Nursing

Surgical classification
• Intramedullary
• Extramedullary
• Extradural
• Level (cervical, thoracic, lumbar)
Histological classification

- Glial
  - Astrocytomas
  - Ependimomas
- Nerve sheath tumors
  - Neurinoma
  - Neurofibroma
- Meningiomas
- Metastasis

Clinical presentations

- Segmental neurological deficit
- Conduction neurological deficit
  - Ascending
  - Descending
- Pain

Additional methods of diagnosis

- MRI
- Postmyelography CT
- Angiography
- Plain xrays
- PET scan
- Bone scan
• Extramedullary tumor on the C1-C2 level (meningioma)

• Neurinoma

• Intramedullary tumor

**Treatment**

- **Surgical**
- **Radiation**
  - For malignant gliomas