SURGICAL MANAGEMENT OF BRAIN TUMORS

LIGIA TATARANU, MD, Ph D

NEUROSURGICAL CLINIC,
“BAGDASAR – ARSENI” CLINICAL HOSPITAL
BUCHAREST, ROMANIA
SURGICAL INDICATIONS

CONFIRMING HISTOLOGIC DIAGNOSIS

REDUCING TUMOR MASS TO THE MAXIMUM EXTENT CONSISTENT WITH OPTIMAL PRESERVATION OF NEUROLOGICAL FUNCTION – RELIEVING MASS EFFECT

INTRODUCING LOCAL ANTINEOPLASTIC AGENTS

PERFORMING CEREBROSPINAL FLUID DIVERSIONARY PROCEDURES
RELATIVE CONTRAINDICATIONS

- MEDICAL FRAILTY
- POOR PERFORMANCE STATUS
- ELOQUENT OR INACCESSIBLE LOCATION
SURGICAL OPTIONS

STEREOTACTIC BIOPSY - FRAME-BASED OR FRAMELESS

CRANIOTOMY

OPEN BIOPSY
TUMOR DEBULKING
TOTAL TUMOR RESECTION

NEUROENDOSCOPY

CEREBROSPINAL FLUID DIVERSIONARY PROCEDURES

RESECTION OF INTRAVENTRICULAR TUMORS
RESECTION OF SKULL BASE TUMORS

FRAMELESS NAVIGATIONAL SYSTEMS, ULTRASONOGRAPHY, ENDOSCOPY, FUNCTIONAL MAPPING, INTRAOPERATIVE IMAGING
STEREOTACTIC BIOPSY

• INDICATIONS:
  • SUPRATENTORIAL:
    • DEEP BRAIN TUMORS, LOCATED PRIMARILY IN THE BASAL GANGLIA, THALAMUS, CORPUS CALLOSUM OR PINEAL REGION
    • DIFFUSE INFILTRATING TUMORS, CHARACTERIZED BY T2-WEIGHTED SIGNAL CHANGE ONLY, WHICH INVOLVE LARGE AREAS OF A HEMISPHERE
STEREOTACTIC BIOPSY

• INDICATIONS:
  • INFRATENTORIAL – TUMORS OF THE BRAINSTEM
  • MULTIPLE BRAIN LESIONS – METASTASES
  • CONTRAINDICATION OF GENERAL ANESTHESIA

MULTIPLE BRAIN METASTASES

NON-HODGKINIAN LYMPHOMA
STEREOTACTIC BIOPSY

• CONTRAINDICATIONS:
  • HIGHLY VASCULARIZED TUMORS – METASTASES OF MELANOMA, CHORIOCARCINOMA, RENAL CARCINOMA, ETC.
  • HEMOSTASIS DISORDERS

• COMPLICATIONS RATE = 1.2 – 7.2 %
  • ASYMPTOMATIC HEMORRHAGE
  • INTRACEREBRAL HEMATOMA = 1.4 %
  • NEUROLOGIC DETERIORATION (NOT DUE TO HEMORRHAGE) = 2.5 %
  • SEIZURES = 0.4 %
  • INFECTION = 0.2 %

• MORBIDITY RATE = 3 – 4 %
• MORTALITY RATE < 1 %
**CRANIOTOMY**

- **AIM: EXTENSIVE TUMOR RESECTION – RATIONALE:**
  
  - **MECHANICAL CYTOREDUCTION CAN:**
    - PROVIDE RAPID 2-LOG CELL KILL
    - REMOVE RESISTANT CELLS
    - PROLONG SURVIVAL
  
  - **SURGICAL DECOMPRESSION CAN:**
    - DECREASE INTRACRANIAL HYPERTENSION
    - IMPROVE NEUROLOGICAL FUNCTION
  
  - **RESECTION MAY POTENTIATE OR FACILITATE:**
    - RADIATION THERAPY
    - CHEMOTHERAPY
    - IMMUNOTHERAPY
    - BRACHYTHERAPY AND HYPERTERMIA
  
  - **EXTENSIVE TISSUE SAMPLING SHOULD BE TAKEN**
CRANIOTOMY

**PREOPERATIVE PLANNING:**

- **PATIENTS SELECTED FOR CRANIOTOMY SHOULD HAVE SOLITARY LESIONS THAT ARE WELL DEFINED ON CONTRAST CT OR MR SCANS + A FUNCTIONAL STATUS OR SOCIAL SITUATION SUFFICIENT TO SUPPORT THEM THROUGH SUBSEQUENT THERAPY.**

- **SMALL POORLY DEFINED LESIONS LOCATED IN CRITICAL REGIONS IN NEUROLOGICALLY INTACT PATIENTS ARE MORE APPROPRIATELY DEALT WITH BY STEREOTACTIC MEANS.**

LEFT FRONTAL ANAPLASTIC GLIOMA
MASS IN THE RIGHT PARAMEDIAN ROLANDIC REGION.  
STEREOTACTIC BIOPSY – PILOCYTIC ASTROCYTOMA (GRADE I).  
RADIOThERAPY

20 MONTHS LATER - ANAPLASTIC TRANSFORMATION OF THE TUMOR.  
SURGERY – HISTOLOGICAL DIAGNOSIS: ANAPLASTIC ASTROCYTOMA (GRADE III)
CRANIOTOMY

• PREOPERATIVE PLANNING:
  • EVALUATION OF THE CLINICAL HISTORY AND OVERALL MEDICAL STATUS
  • ASSESSMENT OF THE IMAGING STUDIES – CT AND MRI SCANS
  • ASSOCIATED HYDROCEPHALUS MAY NEED TO BE MANAGED

CHOROID PLEXUS PAPILOMA – HYDROCEPHALUS
CRANIOTOMY

• **PREOPERATIVE PLANNING:**
  - **ENHANCED MRI SCAN - THE MOST AVAILABLE METHOD FOR PREOPERATIVE PLANNING:**
    - LOCALIZATION OF THE LESION
    - LOCALIZATION OF THE ELOQUENT AREAS – MOTOR STRIP, LANGUAGE AREA, VISUAL CORTEX, THALAMUS, ETC.

SUPRATENTORIAL NEUROBLASTOMA - PNET
CRANIOTOMY

PREOPERATIVE PLANNING:

- DOES THE TYPE OF SUSPECTED PATHOLOGY OR THE SURGICAL APPROACH BEING CONSIDERED REQUIRE ANGIOGRAPHY (MR OR CONVENTIONAL) TO EVALUATE ABNORMAL VASCULARITY, THE POSITION OF NORMAL BLOOD VESSELS OR THE STATUS OF THE VENOUS SINUSES?

PARASAGITAL MENINGIOMA
CRANIOTOMY

- **PREOPERATIVE PLANNING:**
  - DOES THE TYPE OF SUSPECTED PATHOLOGY OR THE SURGICAL APPROACH BEING CONSIDERED REQUIRE ANGIOGRAPHY (MR OR CONVENTIONAL) TO EVALUATE ABNORMAL VASCULARITY, THE POSITION OF NORMAL BLOOD VESSELS OR THE STATUS OF THE VENOUS SINUSES?

“EN PLAQUE” MENINGIOMA
CRANIOTOMY

• PREOPERATIVE PLANNING:
  • IS CT SCAN NEEDED TO EVALUATE BONE ANATOMY, EROSION, CALCIFICATION OR PATHOLOGY?

GLOMUS JUGULARE PARAGANGLIOMA
CRANIO TOMY

**PREOPERATIVE PLANNING:**
- WILL THREE DIMENSIONAL RECONSTRUCTION BE HELPFUL?

PITUITARY ADENOMA
CRANIOTOMY

• PREOPERATIVE PLANNING:
  • WOULD A FUNCTIONAL MRI GIVE USEFUL INFORMATION?
CRANIOTOMY

- **PREOPERATIVE PLANNING:**
  - IMAGE FUSION – FOR CROSS-REGISTRATION OF THE ANATOMICAL DETAILS FOR MRI / CT OR MRI / PET CAN BE USEFUL
CRANIOTOMY

- PREOPERATIVE PLANNING + SURGERY SIMULATION
CRANIOTOMY

• PREOPERATIVE PLANNING:
  • STEREOTACTIC FRAMES CAN BE USED TO GUIDE THE CRANIOTOMY
  • NEURONAVIGATION CAN ALSO BE USE INTRAOPERATIVELY
  • THE MOST DEFINITIVE LOCALIZATION OF ELOQUENT AREAS OF CORTEX IS PROVIDED BY INTRAOPERATIVE ELECTROPHYSIOLOGIC MAPPING
IN GENERAL, THE CRANIOTOMY SHOULD BE PLANNED SO AS TO PROVIDE THE SHORTEST POSSIBLE WORKING DISTANCE BETWEEN THE TUMOR AND THE SURFACE OF THE BRAIN.
SURGICAL EXPOSURE

STANDARD FLAPS FOR INFRATENTORIAL TUMORS
INTRAOPERATIVE CONSIDERATIONS

• THE BONE FLAP SHOULD PLACE THE TUMOR IN THE CENTER OF THE EXPOSED DURA
• THE BRAIN MUST BE RELAXED
• MICROSURGICAL TECHNIQUES PERMIT THE REMOVAL OF RELATIVELY LARGE TUMORS (5 – 8 CM DIAM.) THROUGH RELATIVELY SHORT CORTICAL INCISIONS (1.5 – 3 CM) WITH GOOD FUNCTIONAL RESULTS
• THE CORTICAL INCISION MUST BE ORIENTED PERPENDICULAR TO THE LONG AXIS OF THE SENSORIMOTOR CORTEX
• THE CORTICAL INCISION MUST BE KEPT AS SHORT AS POSSIBLE
• THE SUBCORTICAL TISSUES MUST BE GENTLY SPREAD IN THE LONG AXIS OF THE INCISION UNTIL THE TUMOR IS REACHED
INTRAOPERATIVE CONSIDERATIONS

- OBJECTIVE – TOTAL REMOVAL OF THE TUMOR IF POSSIBLE (INVOLVEMENT WITH CRITICAL STRUCTURES MAY PREVENT A COMPLETE EXCISION)

- SOPHISTICATED TECHNOLOGY FOR REMOVING THE MAXIMAL AMOUNT OF TUMOR WITH MINIMAL RESECTION AND PHYSIOLOGIC DISTURBANCE OF THE SURROUNDING BRAIN:
  - OPERATING MICROSCOPE
  - NEURONAVIGATION
  - INTRAOPERATIVE ULTRASOUND – FOR DEEPER LESIONS
  - ULTRASONIC ASPIRATOR – FOR TISSUES INTERMEDIATE IN FIRMNESS
  - INTRAOPERATIVE ELECTROCORTICOGRAPHY AND STIMULATION – TO CARRY TUMOR RESECTIONS RIGHT TO THE VERY EDGE OF FUNCTIONAL AREAS
RESULTS

• HIGH GRADE CEREBRAL GLIOMAS:
  • MORTALITY RATES = 0- 3.5 %
  • MORBIDITY – INCREASED IN OLDER PATIENTS AND IN THOSE WITH DEEPLY SEATED TUMORS:
    • NEUROLOGIC MORBIDITY RATE = 8 – 20 %
    • POSTOPERATIVE INFECTIONS = 0 – 11 %
    • COMBINED NEUROLOGIC AND MEDICAL MORBIDITY = 31 %
    • THE EXTENT OF SURGERY IS SIGNIFICANTLY RELATED TO THE LENGTH OF SURVIVAL
CONCLUSIONS

• THE ROLE OF NEUROSURGEON IN CEREBRAL TUMOR MANAGEMENT IS TO ESTABLISH A DIAGNOSIS, PRESERVE LIFE AND FUNCTION AND TO EFFECT A CURE IF POSSIBLE.

• SINCE VIRTUALLY NO MALIGNANT TUMOR CAN BE CURED BY SURGICAL RESECTION ALONE, THE TYPE AND EXTENT OF SURGERY OFFERED TO A PATIENT SHOULD BE CONSIDERED IN THE CONTEXT OF OTHER THERAPEUTIC OPTIONS AND SHOULD BE CONSISTENT WITH THE TECHNICAL RESOURCES OF THE PHYSICIAN AND THE PSYCHOSOCIAL RESOURCES OF THE PATIENT AND HIS OR HER FAMILY.

• PROLIFERATING TREATMENT OPTIONS AND TECHNICAL ADVANCES INCREASE THE SAFETY AND EFFICACY OF SURGERY, BUT ALSO INCREASE THE COMPLEXITY OF THE SURGEON’S DECISION MAKING PROCESS.