Primary Brain Tumors: Management and Treatment Options

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Fig. 1.2  Trephined neolithic skull with evidence of new bone formation, indicating the patient had survived the procedure. From Lyon A S, Petrucelli R J, Medicine An Illustrated History. MacMillan, Australia.
Overview

- **Primary Brain Tumors**
  - Gliomas
  - Nerve sheath tumors
  - Meningiomas
  - Pituitary tumors
  - Neuronal tumors
  - Epidermoid/Dermoid
  - Germ cell tumors
  - Choroid Plexus tumors
  - Craniopharyngioma
  - Hemangioblastoma

- **Metastatic tumors**
- **CNS Lymphoma**
- **Benign cysts**
Primary Intracranial Tumors

- Meningioma 20%
- Glioblastoma multiforme 20%
- Anaplastic astrocytoma 15%
- Nerve sheath tumor 10%
- Pituitary adenoma 5%
- Craniopharyngioma 5%
- Medulloblastoma 5%
- Others* 5%
- Ependymoma 2.5%
- Oligodendroglioma 2.5%
- Mixed malignant glioma 5%
- Astrocytoma 5%

*Others:
- Lymphoma
- Hemangioblastoma
- Chordoma
- Ganglioglioma
- Neuroblastoma
- Dermoid
- Pineocytoma/blastoma
- Choroid plexus papilloma/carcinoma
Glial Tumors

- Arise from astrocytes/ oligodendrocytes
- WHO
  - Pilocytic
  - Low grade
  - Anaplastic
  - GBM
- Infiltrate surrounding brain
Glial Tumors

- DNET (dysembryoplastic neuroepithelial tumors)
- PXA (pleomorphic xanthoastrocytoma)
- Brainstem or “Pontine” Glioma
- Oligodendroglioma
  - 1p 19q codeletion
Low Grade Glioma
Low Grade Oligodendroglioma
Anaplastic Astrocytoma
Anaplastic Astrocytoma
Glioblastoma Multiforma (GBM)

- Primary
  - Older
- Secondary
  - TP53 mutations
  - IDH1, R132H
- Butterfly Glioma
Glioblastoma Multiforma (GBM)
Glial Tumors

- Surgical resection
  - Gliadel, gliasite
- XRT, SRS
- Chemo: Temodar, Avastin
- GBM mean survival 6-18 months
- Convection based therapy
Nerve Sheath Tumors

- Acoustic Neuroma, NF
  - Vestibular schwannoma
  - Hearing loss, tinnitus, vertigo
  - Surgery
    - Translabyrinthine, SOC
  - SRS
    - 98% control
- Outcome: hearing, facial nerve, recurrence
Vestibular Schwannoma
Meningiomas

- Arise from the arachnoid
- Benign: 5 yr survival 91%
- Calcium, vascularity
- LOCATION!
- Surgery, SRS
- Observation
Convexity Meningioma
Olfactory Groove Meningioma

- Falx
- Lateral ventricle
- Anterior cerebral arteries
Pituitary Adenomas

- Secreting vs non-
- Macro/micro
- Cushings- ACTH
- Acromegally- GH
- Prolactinoma
  - Bromocriptine
- TSH, FSH/LH, ADH
- Apoplexy
Pituitary Adenoma
Hypothalamic Control of the Pituitary Gland
Acromegaly

GH-secreting adenoma

before epiphyseal closure

after epiphyseal closure

gigantism

acromegaly

cosmic features

enlarged jaw, nose, tongue

cardiac and pulmonary disease

spinal deformity

enlarged hands and feet

diabetes mellitus, arthritis, hypertension
Acromegaly
Cushing’s Syndrome

- obesity
- moon facies
- red cheeks
- buffalo hump
- ecchymoses
- osteoporosis
- hypertension
- pendulous abdomen
- purple striae
- amenorrhea
- diabetes mellitus
Figure 34.16 Catheter placement for simultaneous blood sampling of the inferior petrosal sinuses. The confluent pituitary veins empty laterally into the cavernous sinuses, which drain into the inferior petrosal sinuses. (Adapted from Oldfield EH et al, 1985)
A.17 A cartilage swivel kni is used to incise the inferior-anterior margin the septal cartilage. The septal cartilage spheram, measuring 15 mm in diameter, is tamed for subsequent use in the reconstru of the sella turcica floor.

A.18 This axial view demNES the elevation of the nasal mucosa a dislocation of the cartilaginous septum for the bony septum and perpendicular plate the ethmoid.
A.22 Using an angled rongeur, the surgeon removes the bony margins of the anterior wall of the sphenoid sinus. The mucosa of the sphenoid sinus is dissected free, grasped with a pituitary rongeur, and removed.

A.23 The floor of the sella turcica and the bilateral prominences of the internal carotid arteries are visualized. The remaining sphenoid septum is removed. The sella is opened by positioning a chisel on the sellar floor. Lateral image intensification verifies correct chisel position, which should be at the lower third of the sellar floor. A midline trajectory is confirmed by aligning the anterior nasal spine and perpendicular plate of the ethmoid. A 3 x 5 mm opening is outlined (fractured) with the chisel.
Craniopharyngioma

- Arise from pituitary or III
- Peak age 5-10 years
- Endocrine eval
- Solid/cystic
  - Cholesterol crystals, aseptic meningitis
- 5 year survival 55-85%
  - Hypothalamic injury
Fig. 45.1 A–C. Development of Rathke's pouch and hypophysis.
Craniopharyngioma

- Optic tract
- Anterior cerebral artery
- Pituitary gland
Hemangioblastoma

- von Hippel-Lindau (retinal angiomas, RCC)
- Posterior fossa
- Polycythemia
- Solid vs Cystic/ nodule
- Surgery
Hemangioblastoma
Neuronal Tumors

• Ganglioglioma
• Glomus Jugulare
• Ependymoma
  – Cranial, spinal
  – Floor of IV
  – Drop mets
  – Resection and XRT
• Medulloblastoma
Pineal Region Tumors

- Germ Cell Tumors
  - Midline: suprasellar and pineal
  - Germinoma (XRT)
  - Choriocarcinoma, teratoma
  - BHcg, AFP

- Pineocytoma/ Pineoblastoma

- Gliomas

- Cysts
Midline Anatomy
Dermoid, Epidermoid

- Developmental anomaly
  - Retained ectodermal inplants
- Growth rate linear (vs exponential)
- Epidermoid
  - Sellar, CP angle, IV, spinal cord
  - Aseptic meningitis
- Dermoid
  - Midline, other congenital anomalies 50%
  - Bacterial meningitis
Epidermoid
Choroid Plexus Tumors

- 70% < 2 years old, neonates, HCP
- Benign vs malignant
- Surgical resection
- Hydrocephalus
Choroid Plexus Papilloma?
Chordoma

- Clivus or sacrum
- Physaliphorous cells (mucin)
- Slow growing
- Radioresistant (Proton beam therapy)
Chordoma
CNS Lymphoma

- Primary vs secondary
- CVD, immunosuppression, EBV
- Carcinomatous meningitis, seizure
- Steroids
- Biopsy
- XRT, chemo (Ommaya)
Primary CNS Lymphoma
Benign Lesions

- Arachnoid cysts
- Rathke cleft cyst
- Colloid Cyst
  - Obstructive hydrocephalus
- Lipoma
Arachnoid Cyst
Figure 51.1 Arachnoid cyst and its relation to the meninges and the subarachnoid space.
Colloid Cyst
Figure 36.4 Gross coronal section of a pathological specimen demonstrating a small colloid cyst impacted between the foramen of Monro. The lateral ventricles are only mildly enlarged.
Interhemispheric Approach
Approach A.100  

An image guidance probe is used to determine the bone flap position to ensure the surgeon’s line of trajectory to the lesion. In addition, surface anatomy and venous tributaries may be assessed to determine trajectory to the lesion. Two entry burr holes are made adjacent to the superior sagittal sinus. The edge of the superior sagittal sinus is dissected from the bone. A bone flap (4 × 6 cm) positioned two-thirds anterior and one-third posterior to the coronal suture is cut with a craniotome. The cut along the sagittal sinus is always made last so that if the sinus is injured the bone flap can be immediately elevated, enabling sinus bleeding to be controlled and repaired.
Figure 49.13 The three rectilinear planes in which a stereotactic frame measures. (Courtesy of E Dolan, Billings, Mont)
Figure 49.16 The position of the oblique fiducial bars, shown in Figure 49.15, in the axial image of the brain identifies which axial cut is being examined. For the Leksell frame they bear a 45° angle with the vertical bars so that the distance $z$ of their images from the midpoint between the vertical bars is also the distance above or below the middle of the vertical bars. (Courtesy of E Dolan, Billings, Mont)
Figure 49.17 The anteroposterior and mediolateral coordinates of a target can be measured directly. (Courtesy of E Dolan, Billings, Mont)
Figure 42.3 Cross-sectional diagram of the 201-source gamma knife (United States model) with the patient in position during irradiation. The cobalt-60 sources are focused at a central point. CT, MR, or angiographic guidance is used to place the desired target at the focal point. (Adapted from Coffey RJ, Lunsford LD, 1990)
Figure 42.10 The “Boston” radiosurgical system designed by Winston and Lutz. The principle is similar to most linear accelerator-based systems. Rotation of the patient (fixed horizontally within a stereotactic frame and floor or table-mounted support system) to various couch angles, causes the photon beam to enter the skull through multiple, noncoplanar, sagittally oriented arcs (inset). The final beam collimator, having inserts of various sizes, is brought relatively close to the patient’s head to minimize the radiation penumbra and to optimize beam alignment. (Adapted from Winston KR, Lutz W, 1988 and Columbo F, Benedetti A, Pozza F, et al., 1985)