POST FOSSA TUMORS DIAGNOSIS AND TREATMENT

Introduction

Primary brain tumor – 6 persons/100000/year

Metastatic brain tumor – 6 persons/100000/year

1 in 15 primary brain tumors occur in children under 15 years

In adults, the commonest tumors are gliomas, metastases and meniongiomas; most lie in the supratentorial compartment

Intra-axial Post Fossa Tumors

Adult

- Metastasis 16%
- Hemangioblastoma 7-12%
- Pilocytic astrocytoma (2nd decade)
- Brain stem glioma (1% of adult tumor)
- Choroid plexus tumor (<1% of primary brain tumor)
- Cerebellar liponeurocytoma

Paediatric

- PNET (including medulloblastoma) 27%
- Cerebellar (Pilocytic astrocytoma) 27%
- Brain stem glioma 27%
- Ependymoma 15%
- Choroid plexus papilloma (<1% of primary brain tumor)
- Dermoid cyst (<0.5% of primary intraaxial tumor)
- Atypical teratoid/ rhabdoid tumor

Extra-axial Lesion

- Vestibular schwannoma
- Meningioma
- Epidermoid
- Metastases
- Trigeminal neuroma
- Facial nerve neuroma
- Arachnoid cyst

Metastases

- Cerebellum is a common site
- 16% of cases of solitary brain mets
- MC post fossa tumor in adults

Primary

- Lung – 44%
- Breast – 10%
- Kidney (renal cell) – 7%
- GI – 6%
- Melanoma – 3%
- Undetermined – 10%

Pathology

- Rounded solid partially cystic mass ± edema

Age

- Rare in children, most common in older adults (> 40 years)

Location

- Anywhere: grey white junction most common site

Imaging

- NECT: Iso / hyperdense; Ca^{++} rare in untreated metastases
- CECT: Strong solid/ring enhancement
- MR: Most hypointense on T_1, hyperintense on T_2W_1, most enhance moderately intensely following contrast administration

Management

- Mostly palliative
- Median survival of patient 26-32 weeks

Medical

- Corticosteroids
- Anticonvulsants.

Surgical Management

Solitary lesion

Surgical excision of solitary lesion:

- Primary disease quiescent or radioresistant
- Lesion accessible, symptomatic or life threatening
- For recurrent small cell lung carcinoma following XRT
- Diagnosis unknown

Multiple Lesions

- Worse prognosis than solitary lesion
- Usually treated with XRT without surgery

Situations where surgery is done:

- One particular and accessible lesion symptomatic and/ or life threatening
- Multiple lesions that can all be completely removed

Stereotactic Biopsy

- Lesions not appropriate for surgery
- Not candidates for surgical resection
- To ascertain a diagnosis

Stereotactic Radiosurgery

- No mass effect, no hydrocephalus
- **Advantage:** No risk of hemorrhage, infection or mechanical spread of tumor cells, Can be used for 3 or fewer mets
- **Disadvantage:** Histological proof not obtained, Cannot be used for lesion > 3 cm

Median survival following craniotomy

	Month
Lung	11
Breast	11
Colon	8
Kidney	12
Melanoma	6.5
Miscellaneous	11
Sarcoma	6
Urologic (testis, Bladder, Prostate)	10
Unknown	10
Esophagus	4

Median survival even with best treatment is only – 8 months

Hemangioblastoma (HGB)

- Most common primary intra-axial posterior fossa tumor in adults (7-12% of post fossa tumors)
- Highly vascular well circumscribed solid or cystic neoplasm of CNS or retina
- May occur sporadically (4th Decade) or as part of Von Hippel Lindau disease (3rd decade)
- 30% of patients with cerebellar HGB have VHL

Pathology

- 60% cystic with nodule – 40% solid
- Gross hemorrhage, calcification necrosis rare

Age

- Adults with peak during 40 to 60 years, rare in children

Location

- 80% to 85% cerebellum
- 3% to 13% spinal cord
- 2% to 3% Medulla

Supratentorial lesions occur but are uncommon

- 60% of patients with VHL have retinal lesions

Imaging

- Vertebral Angiography: Vascular nodule with intense, prolonged stain ± avascular cyst
- CT: Low density cyst with strongly enhancing mural nodule that abuts a pial surface
- MR: Cyst slightly hyperintense to CSF on T_1W_1; hyperintense to brain on T_2W_1; mural nodule variable but enhances strongly

Labs

- Polycythemia
- Catecholamine production from pheochromocytoma

Treatment

- May be curative in cases of HGB, not in VHL
- Preop embolisation reduces the vascularity
- Cystic hemagloblastoma require removal of mural nodule.

Stereotactic Radiosurgery

- For asymptomatic HGB > 5 mm diameter if they are cystic or progressing in size during surveillance

Radiation Treatment

- Effectiveness dubious
- May be useful to reduce tumor size or to retard growth in patients who are not surgical candidates for multiple brainstem HGB

Chemotherapy

- Ongoing phase II trial with Sunitnib, an inhibitor of vascular endothelial growth factor and platelet derived growth factor

MEDULLOBLASTOMA

Origin of cells (WHO- PNET)

Static- external granular layer

Origin from remnant of cells of the external granular layer of the cerebellum.

Dynamic – neural progenitor cells

Transformation of normal undifferentiated progenitor cells of superior medullary velum which migrate to the fourth ventricle

MEDULLOBLASTOMA

Histology

- Medulloblastoma (Grade 4)
  - Desmoplastic/nodular medulloblastoma
  - Medulloblastoma with extensive nodularity
  - Anaplastic medulloblastoma
  - Large cell medulloblastoma

MEDULLOBLASTOMA

- ***Histology***

Cellular, small cells, scant cytoplasm, Homer-Wright rosettes

Immuno histochemistry

GFAP +

EMA –

MEDULLOBLASTOMA

CLINICAL FEATURES

HYDROCEPHALUS : RAISED ICP

- BEHAVIORAL CHANGE, LISTLESSNESS, IRRITABILITY, VOMITING, AND

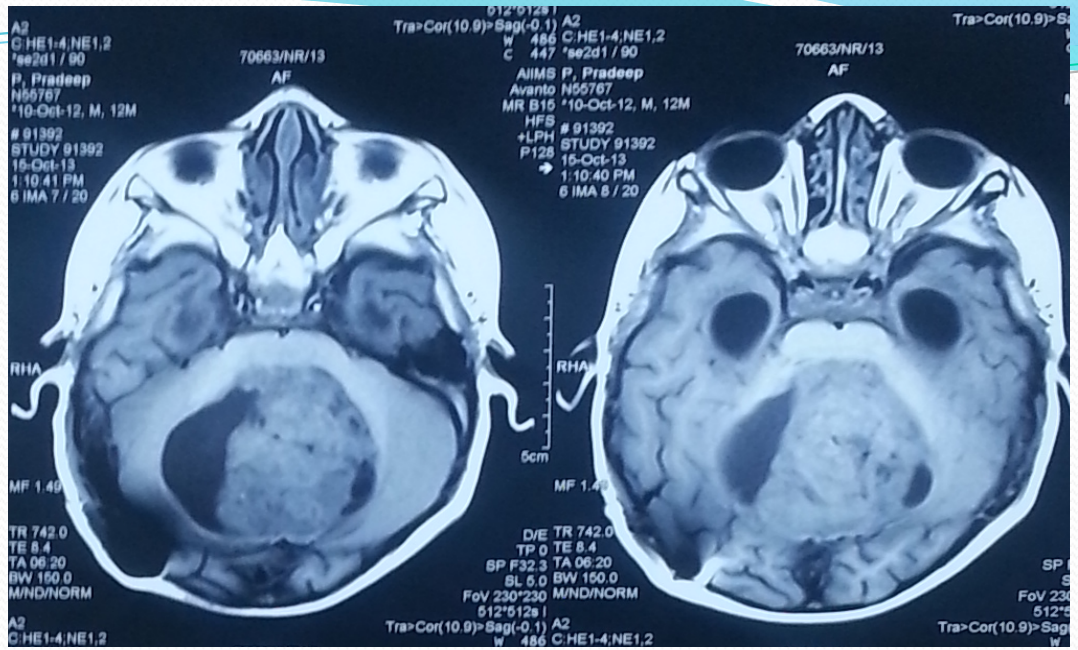
  DECREASED SOCIAL INTERACTIONS.
- HEADACHE
- DOUBLE VISION.
- HEAD TILT : TONSILLAR HERNIATION BELOW THE FORAMEN MAGNUM
- CEREBELLAR SYMPTOMS
- BRAIN STEM INVOLVEMENT
- LEPTOMENINGEAL DISSEMINATION

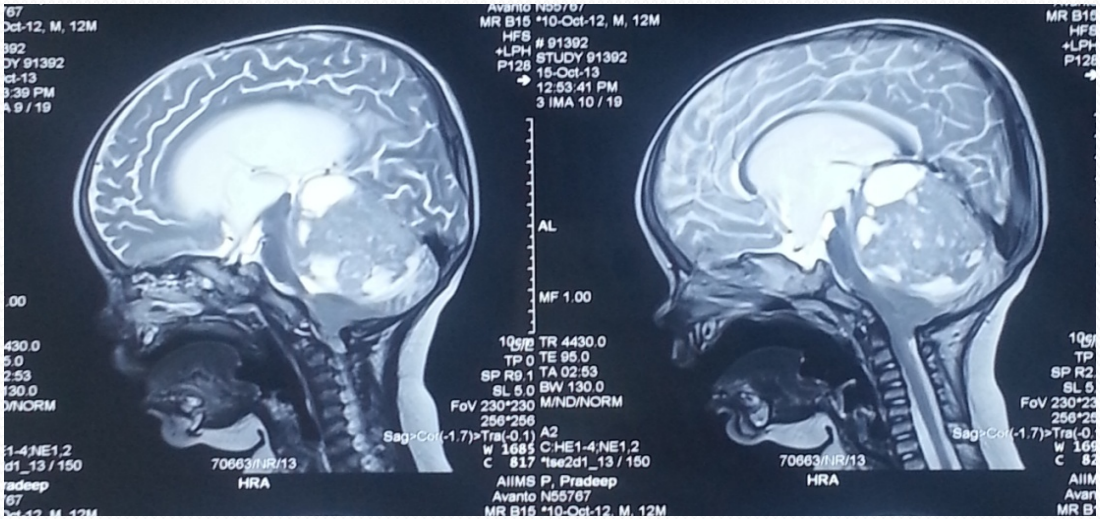
MEDULLOBLASTOMA

Examination

- Increasing head circumference , full anterior fontanelle with widely split cranial sutures.
- Papilledema 90% of patients
- Diplopia and lateral gaze paresis
- Fourth cranial nerve palsy (should be considered in any patient with a head tilt)
- Nystagmus
- Cerebellar signs (ataxia > unilateral dysmetria)

MEDULLOBLASTOMA





MEDULLOBLASTOMA

- **MRI-** T1- low to isointense T2- hyperintense
- Homogenous contrast enhancement
  (may be absent in about 15 –20 %)
- DWI shows restricted diffusion with increased ADC.

Spinal imaging –

- **At diagnosis** (11-71% show dissemination)
- **Within 24 hrs** after surgery or **2 weeks** post surgery
- Surveillance imaging at **3-6 months**

MEDULLOBLASTOMA

- Management

  Steroids

  CSF cytology- LP, EVD, Cisternamagna

  CSF diversion

  Definitive surgery

  Adjuvant therapy

MEDULLOBLASTOMA

CHANG CLASSIFICATION

Stage	Feature
Tumor stage	
T1	Less than 3 cm diameter, limited to vermis, roof of fourth ventricle, or hemisphere
T2	More than 3 cm diameter, invades one adjacent structure or partially fills fourth ventricle.
T3a	Invades two adjacent structure or completely fills fourth ventricle with extension into cerebral aqueduct, foramen of Luschka, or formen of Magndie.
T3b	Arises from floor of fourth ventricle or brain stem; fourth ventricle completely filled
T4	Spreads to involve cerebral aqueduct, third ventrical, midbrain, or upper cervical spinal cord
Metastasis stage	
M0	*No evidence of metastasis*
M1	Tumor cells in CSF
M2	Gross nodular seeding of brain CSF spaces
M3	Gross nodular seeding of spinal CSF spaces
M4	Extraneural spread

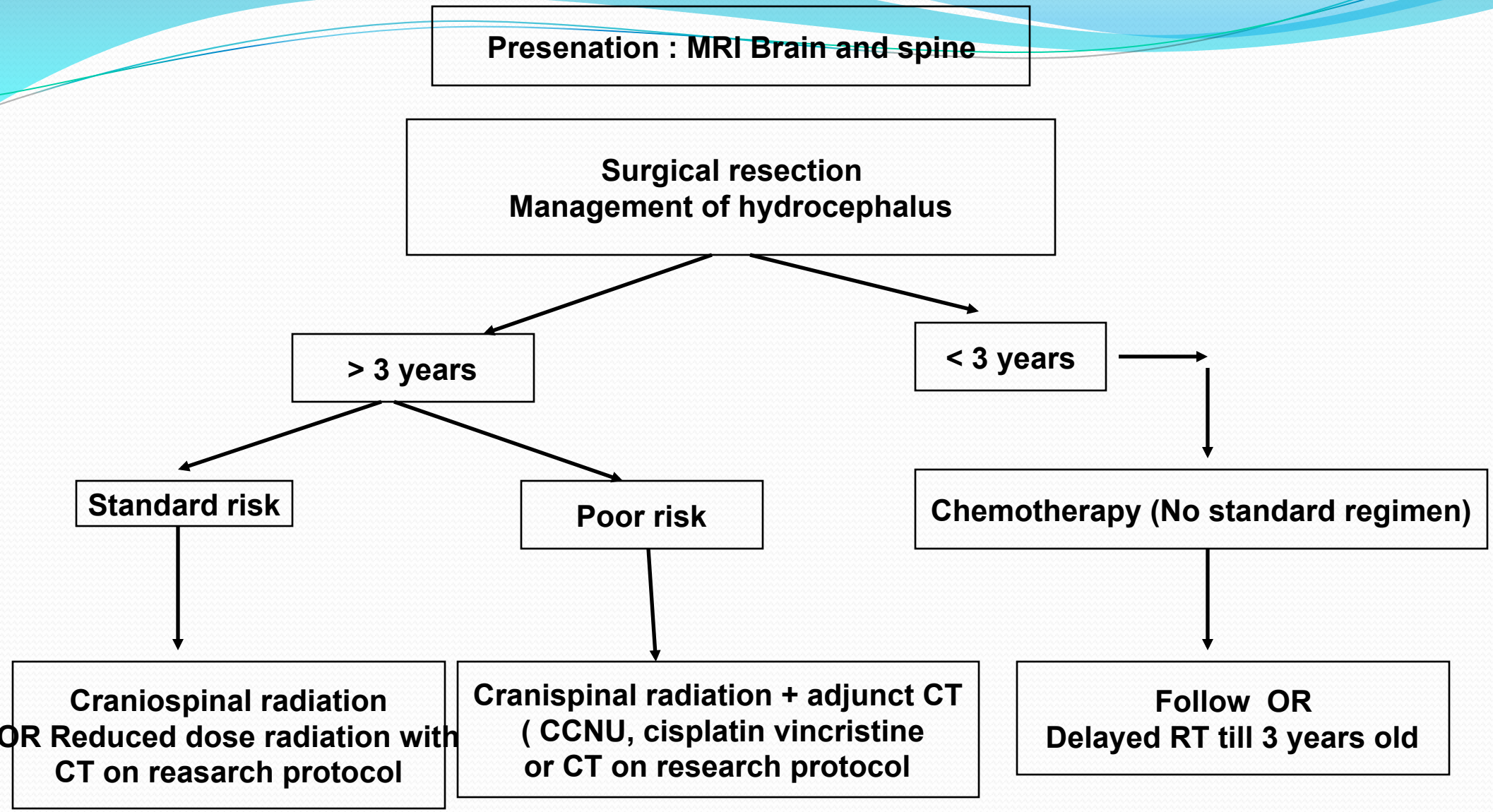
Current staging of medulloblastoma

STANDARD RISK

- No residual tumor on postop MRI and negative CSF result
- 5 years survival is >5% and progression free survival = 50%

HIGH RISK

- Bulky residual tumor > 1.5 cm^2 postop
- Dissemination in the brain, spine or CSF
- Worse prognosis
- 5 year disease free survival is 35-50%



Management algorithm for medulloblastoma

Management..... Surgery

- Gross Total Resection, if possible (arises from roof of fourth ventricle- soft reddish vascular with some times sugar coating).
- Brainstem damage should be avoided.
- Resolution of natural CSF pathways.
- SURGERY alone : **NOT CURATIVE**
- RADIOTHERAPY : Cornerstone of adjuvant therapy.
  - 54 to 58 Gy - primary site
  - 35Gy - craniospinal axis

Management…….. Recurrent Medulloblastoma

- Chemotherapy : limited due to chemo resistance in those patients who have previously undergone CT
- Redosing with RT avoided due to radiation necrosis
- High-dose chemotherapy with autologous SCR or autologous BMR: subject of intense investigation

Prognosis

- 5 - year recurrence-free survival rates : 55% - 67%.
- Most common site : **PRIMARY TUMOR SITE**

Ependymoma

- 10% of brain tumors in children
- Peak age - 0-4yrs
- Male preponderance
- Children 90% in cranium
- Adults in spinal

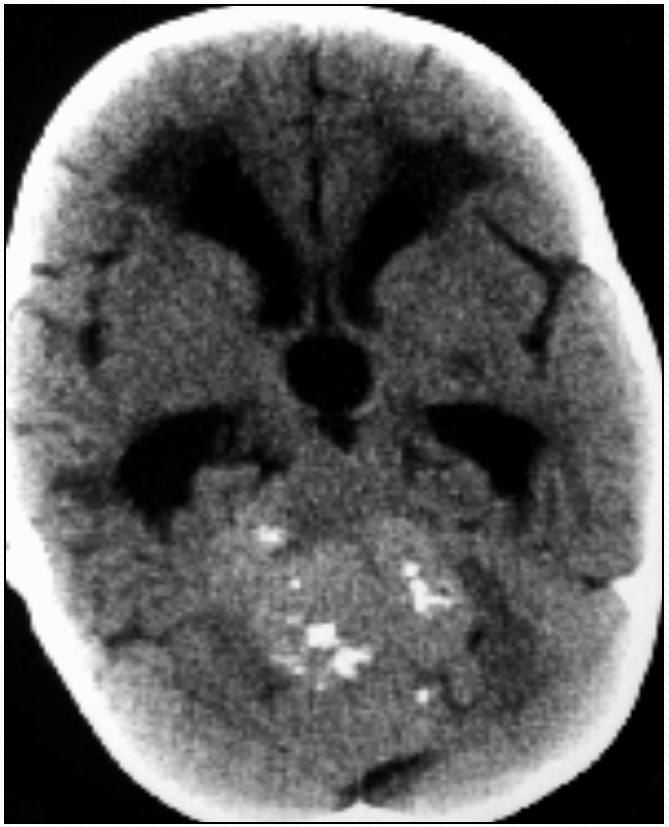
EPENDYMOMA

- MYXOPAPILLARY (WHO Grade 1)
- SUBEPENDYMOMA (WHO Grade 1)
- Ependymoma (WHO Grade 2)
  - Cellular
  - Papillary
  - Clear cell
  - Tanycytic
- Anaplastic ependymoma (WHO Grade 3)

Ependymoma ..... Imaging

CT : Typically isodense with heterogenous enhancement

Calcification : common (can be seen in one half of cases)



Ependymoma.....MRI

- On MRI, heterogeneous secondary to necrosis, hemorrhage and calcification.
- Heterogenous contrast enhancement
- Plasticity
- Extension to the cerebellopontine angle is characteristic of ependymomas

Ependymoma.....

- **INTRA OP-** Tumor arises from the floor and is greyish

  lobulated gritty and firm

- **Staging:** No conventional staging criteria.

- Postoperative MRI is recommended within 48 hours

Ependymoma…Role of Radiotherapy

- Post-operative radiation recommended for patients older than 3 years.
- Stereotactic radiosurgery : Therapeutic option in patients with residual, unresectable or recurrent tumor

Role of Chemotherapy

- May be useful < 3 years : Delay cranial radiation
- Childhood intracranial ependymomas : in general chemo-resistant

AIIMS Protocol

Low Grade

CSF -VE

↓

Surgery

↓

Radiotherapy
56Gy / 28# / 5.5 wks
(50 Gy followed by a boost of 6 Gy)

High grade

CSF + VE

↓

Surgery

↓

Surgery followed by CSI and 6 cycles chemotherapy.

Cerebellar (Pilocytic astrocytoma)

- 10-20% of pediatric brain tumour
- Pilocytic astrocytoma is the most common pediatric central nervous system glial neoplasm
- Benign : extremely high survival rate 94% at 10 years
- Most patients present in the first 2 decades

Pilocytic astrocytoma....MRI

Four predominant imaging patterns :

Mass with a nonenhancing cyst and an intensely enhancing mural nodule (21%)

Mass with an enhancing cyst wall and an intensely enhancing mural nodule (46%)

Necrotic mass with a central nonenhancing zone (16%), and

Predominantly solid mass with minimal to no cyst like component (17%)

Pilocytic astrocytoma….

- Surgical resection of cerebellar pilocytic astrocytomas is considered the treatment of choice
- Resection of mural nodule – key surgical objective
- Resection of cyst wall – controversial ??
- Radiation therapy is strictly avoided, given its risk of causing significant morbidity in children younger than 5 years of age

Brainstem gliomas (BSG)

- 75% in children, 25 % in adults
- Median-6.5years
- 1 % of pediatric brain tumors and 25 % of pediatric post fossa tumors
- 75% diffuse variety
- Either very benign or malignant

HALLMARKS OF BSG

- Bilateral long tract signs
- Bilateral multiple contiguous cranial nerve palsies
- Horner's syndrome
- Inter Nuclear Ophthalmoplegia

BSG.....Classification

- The most recent classification system by Choux et al based on both CT and MRI imaging

  - Type I – Diffuse
  - Type II – Intrinsic, focal
  - Type III – Exophytic, focal
  - Type IV – Cervicomedullary

- Pediatric Neurosurgery. New York, Churchill Livingstone, 2000, pp 471–491.

BSG……

- Type I : Diffuse brainstem gliomas
  - 75% of all BSG
  - Hypointense on CT
  - No significant enhancement on MRI.
  - Characterized by diffuse infiltration and
  - swelling of the brainstem.
  - Typically, are malignant fibrillary
  - astrocytomas (WHO grade III or IV).

BSG……

- Type II : Focal intrinsic tumors (cystic/solid)
- Sharply demarcated from surrounding tissue on MRI and are associated with less brainstem edema.
- Majority of these lesions are low grade gliomas (WHO I or II).
- Contrast enhancement : variable

BSG……

- Type III : Exophytic tumors that arise from the subependymal glial tissue of the fourth ventricle and mostly grow dorsally or laterally.

- MRI characteristics similar to type II lesions, and histologically, these lesions are usually low-grade lesions (WHO I or II) like type II lesions.

BSG……

- Type IV lesions are cervicomedullary brainstem gliomas.
- Imaging, histology and behavior : similar to intramedullary spinal cord gliomas.
- Majority are low-grade, non-infiltrative tumors.

BSG.....Management

- Biopsy : only for indeterminate lesions
- Stereotactic biopsy: can provide diagnostic tissue.
- Stereotactic radiosurgery
- Not without risk:

Damage to the cranial nerves and long tracts

Tissue heterogeneity

MANAGEMENT

- Focal cystic tumors- SX+RT
- Focal solid tumors- SX
- Dorsal Exophytic tumors- SX + Focal RT
- Dorsal Exophytic malignant tumor- RT+CT
- Diffuse infiltrating – RT + steroids

Choroid Plexus Tumors

- Neoplasms of the choroid plexus.
- Lateral ventricles : most common location in children.
- 4^{th} ventricle : most common location in adults.
- 4-6% of the intracranial neoplasms in children younger than 2 years.
- Choroid plexus tumors
  - Choroid plexus papilloma (WHO Grade 1)
  - Atypical choroid plexus papilloma (WHO Grade 2)
  - Choroid plexus carcinoma (WHO Grade 3)

Choroid Plexus TUMORS…..Clinical

- Hydrocephalus and raised ICT
- The tumor itself can cause mass effect.
- Surgery may not resolve HCP

  (derangement of reabsorption mechanisms or blockage at other sites in the ventricular system)

Choroid Plexus Papilloma...Management

- Treatment of hydrocephalus must be considered both before and after any surgical procedures.
- An acute increase in ICP : V P Shunt.
- Hydrocephalus often resolves following removal of the mass.

Choroid Plexus Papilloma...Management

- Total surgical resection is the goal.
- Complete removal: generally curative in papilloma
- Choroid plexus carcinoma -total resection leads to the best possible outcome.
- Adjuvant CT and RT have been demonstrated to increase survival

Dermoid cyst

- Congenital ectodermal inclusion cysts.
- Extremely rare < 0.5% of primary intracranial tumors
- Midline sellar, parasellar, or frontonasal regions : most common sites.
- Posterior fossa (vermis or within the 4^{th} ventricle)
- Growth can lead to rupture of the cyst contents, causing a chemical meningitis that may lead to vasospasm, infarction, and even death

Dermoid cyst

- Well - defined, lobulated, “pearly” mass of variable size.

- Characteristically - cyst contains thick, disagreeable, foul smelling, yellow material due to the secretion of sebaceous glands and desquamated epithelium

- The cysts may also contain hair and/or teeth

Salient steps in surgery

- Midline incision
- V shaped fascia opening
- Craniotomy
- Dura opened in y shaped
- Arachnoid opened
- Cottonoid placed over cisterna magna and floor of fourth ventricle

Cerebellar tumors

- Hemispheric tumor approached via thinnest portion through horizontal incision
- Midline tumor via vermis splitting or Telovelar approach

IVth ventricular tumors

- Telovelar approach or vermian splitting
- Dorsal portion debulked, shave off the floor
- Aqueduct , roof floor , lateral recess and obex inspection

Brainstem tumor

Dorsal exophytic tumor-

Identify superiorly and inferiorly normal brain stem

Start superior pole till iv ventricular floor , tumor slowly separated till it is completely removed.

Focal brainstem tumor-

safe passage through brainstem using EMG and tumor bulking from core to periphery.

Complications

- Pseudomeningocoele
- Cranial nerve paresis
- Mutism
- Subdural hygroma
- Aseptic meningitis
- Cerebellar cognitive affect syndrome

CONCLUSION

- Pilocytic astrocytoma bears the best outcome.
- Management of hydrocephalus still remains controversial.
- Though surgery and RT remains the treatment of choice for medulloblastoma; optimal craniospinal radiation dose remains debatable.
- Outcome for brainstem gliomas remains dismal.

Thank You