Tumors of the CNS

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Facts and Statistics

- 36,400 people diagnosed with primary brain tumor and 150,000 yearly with brain mets
- Most common primary brain tumors:
  - Meningioma
  - Glioblastoma Multiforme
  - Astrocytoma G1, Pituitary tumors
  - Acoustic Neuroma
  - Anaplastic Astrocytoma GIII, Primary CNS Lymphoma Oligodendroglioma 2\textsuperscript{nd} most common cause of death in children under age 20 and 3\textsuperscript{rd} in adults 20 to 39
Types of Brain Tumors

World Health Organization Classification of Brain Tumors 2000
Astrocytomomas

- Derived from and composed of astrocytes
- Common in 30-50 year olds
- Usually supratentorial in adults and infratentorial in children
- More rapid growing than meningiomas
- Not well differentiated from edematous or necrotic brain
  - Rarely encapsulated
  - Can become encapsulated
- Outgrows own blood supply and can double in size every 7-10 day
Astrocytoma (Cont)

- Classified in grades by malignancy
- Diffuse Astrocytoma- Grade I & II
- Anaplastic Astrocytoma- Grade III
- Glioblastoma Multiform (GBM)- Grade IV
Diffuse Astrocytoma – WHO grade II

- Well defined cells
- Usually found in cerebrum, cerebellum (brain stem in children)
- Peak incidence 20 – 40 years
- Mean survival 5-7 years
Anaplastic Astrocytoma – WHO grade III

- Biologically aggressive
- Found in hemispheres (Pons, Thalamus in children)
- Peak 30-50 years
- Mean survival 18-24 months
Glioblastoma Multiform (GBM) - WHO Grade IV

- Most common primary brain tumor
- Most malignant form of primary brain tumors
- Mean Survival 8-10 months
- Rapidly growing with areas of necrosis
- Found in hemispheres (brain stem in children)
- Men > women, peak 50-70 years
Oligodendroglioma

- Many grade II diffuse astrocytomas are considered oligodendrogliomas
- Located usually the hemispheres
- Well differentiated, can be calcified
- Seizures are the 1st S/S in about 50% of pt’s.
Ependymoma

- Slow growing tumor
- Usually arises from the ependymal cells lining of the ventricles (70% in the 4th ventricle/ adults in spine)
- Can seed along the spinal cord
- Rapid IICP due to hydrocephalus
- Generally occurs in first 2 decades of life
Pineal Tumors

- Arises from pinocytes
- Peak 20-50 years
- Causes hydrocephalous
Medulloblastoma

- Malignant small cell tumor of the cerebellum
- Infant to 20 generally
- Cerebellar sx
PNET

- Medulloblastoma like neoplasms
- Generally by 7 years of age – rare in adults
- Aggressive
- Hydrocephalous
Schwannoma

- Benign neoplasm from the Schwann cells
- Commonly occurs on sensory nerves - esp CN VIII
- Peak 20-50 years
Neurofibroma

- Benign peripheral nerve sheath tumor
- Multiple lesions - key component of neurofibromatosis type I (NF I)
- Bilateral Vestibular Schwannoma – key component of neurofibromatosis type II (NF II)
Meningioma

- Tumors of the meninges, slow growing
- Usually benign, can erode bone
- Highly vascular, gets blood supply from meninges
- Easily differentiated from normal brain tissue
- Adults W3:M2
Hemangioblastoma

- Blood vessel origin – highly vascular
- Peak 20-40 years
- Genetically associate with VHL dz
- Hydrocephalous
Pituitary tumors

- From the anterior pituitary
- Benign but cause endocrine dysfunction – Cushing’s dz, acromegaly, prolactinoma
- Can compress the optic chiasm, distend the sella turcica, or encroach on the cavernous sinus
- Microadenoma <1cm, Macroadenoma >1cm
- Peak 20-50 years W>M
Craniopharyngioma

- Arises from epithelial tissue
- Usually cystic
- Located in sellar or 3rd ventricle region
- Cystic
- Affects children > adults
- Applies pressure on the optic chiasm, hydrocephalous, hypothalamic-pituitary axis dysfunction
Dermoid and Epidermoid Cysts

- Slowly enlarging
- Found in meninges and ventricles
Metastatic brain tumors

- Primary sites: lung, breast, skin, kidney, and GI
- Generally spherical, contrast enhancing, with a necrotic center and peri tumor edema
S/S of Brain Tumors - Frontal

- Higher functions
- Attention
- Mood
- Emotions
- Insight
- Judgement
- Memory
- Personality
- Problem Solving

- Incontinence
- Gait
- Contralateral motor
- Speech
S/S of Brain Tumors - Frontal - Temporal

- Language
- Visual pathways
- Sensory seizures
S/S of Brain Tumors - Parietal

- Contralateral Sensory
- Neglect
- Proprioception
- Stereognosis
- Agraphia
- Acalculia
- Finger Agnosia
- Visual/Spatial orientation
- Dyspraxia
S/S of Brain Tumors - Occipital

- Visual Perception
S/S of Brain Tumors - Cerebellum

- Nystagmus
- Ataxia
- Dysmetria
S/S of Brain Tumors – 4th Ventricle

- Nausea
- Vomiting
- Disequilibrium
S/S of Brain Tumors – Brain Stem

- Multiple cranial nerve deficits
S/S of Brain Tumors - Hypothalamus

- Appetite
- Temperature regulation
- Sexual function
- Motivation
Subjective Sx

- Head aches – morning headaches
- HA associated with projectile vomiting – IICP
- Mental status changes
- Visual Symptoms
- Seizure
Diagnosis of Brain Tumor(s)

Neurological Exam
CT Scan
MRI
CT Scan

- X-rays do not show tumors located behind bones of the skull and spine
- CT is better than MRI at showing calcification and bony erosion
- Use of dye makes abnormal tissue more obvious, the dye concentrates in diseased tissue greater than healthy tissue due to “leakiness” of blood vessels in and around tumors
MRI and Angiograph and MRI angiograph (MRA)

- MRI is used in small tumors next to the bone, brainstem tumors, low grade tumors and metastatic tumors
- Angiograph and MRA used for planning surgical removal of a tumor with suspected large blood supply or an area with an abundance of blood vessels
Misc. test for brain tumors

- **PET Scan** - used to distinguish between recurrent tumor vs necrosis due to radiation vs scar tissue

- **Lumbar puncture** - used with caution if suspected IICP. Used to find tumor markers found in CNS Lymphoma. Most primary brain tumors have no tumor markers

- **Audiometry** - hearing test done if suspected Acoustic Neuroma
Misc. test for brain tumors (cont)

- **Evoked potentials** - use of a small electrode to measure the electrical activity of a nerve (Acoustic Neuroma)
- **Endocrine test** - suspected pituitary tumor
- **Biopsy** - for diagnosis in inoperable tumors
Treatment of Brain Tumors

Surgery
Radiation
Chemo
Gene therapy
Surgery

- Biopsy
  - Open
  - Needle
  - Sterotactic needle
- Craniotomy
  - Conventional and sterotactic
- Craniectomy
- Shunting
Surgical techniques and tools

- **Brain mapping** - help identify the tumor margins. Done by direct cortical stimulation, evoked potentials, MRI/MRA, and intra-op ultrasound imaging

- **Embolization**
- **Endoscopy**
- **Lasers** in skull base or deep brain tumors
- **Microsurgery** used to magnify the surgical field
Surgical techniques and tools

- **Polymer wafer implants** - removal of tumor then wafers are placed into the cavity

- **Transpheniodal approach** - surgery through the spheniod bone to approach a Pituitary tumor or Craniopharyngioma tumor

- **Ultrasonic aspiration** - ultrasonic waves cause vibrations that fragment the tumor then the pieces are suctioned out
Radiation therapy

- Used
  - Following tumor removal
  - Inoperable tumors
  - Palliative symptom management

- The brain struggles to clear away dead tumor cells so it can be several months of longer before the full effect of radiation is known
Sterotactic radiosurgery

- Not surgery, a precise, high dose beam delivers radiation to be delivered to a small, localized area of the brain
- Used to treat small brain tumors (3cm or less) that cannot be surgically removed or partially removed or given for a one time “boost” at the end of conventional radiation therapy
- Given by:
  - Gamma knife
  - Linear accelerators
  - Cyclotrons
Chemotherapy

- Oral
- IV
- Intrathecal – spinal tap or Ommaya reservoir
- Intraarterial
- Directly into tumor
Post-op Care
Objectives of nursing management

- Extensive physiological monitoring
- Frequent assessment and monitoring of neurological signs of rapid IICP
- Control factors known to contribute to IICP
- Prevention and early recognition of other complications
- Supportive and emotional care
- Begin early rehabilitation and discharge planning
Neuro ICU care

- Frequent neurological exam
- Strict SBP
- Placed on cardiac and apnea monitor
- Usually pt will have arterial line and 2 IV’s
- Possible ventriculostomy or subarachnoid drain
- Possible ventilator
- Always have bedside suctioning available
- Bedrest with HOB elevated 30 degrees
Neuro ICU care (cont)

- Ted hose and scds
- Foley
- Assess swallowing prior to diet
- Check head drsg at least Q4H
- Blood chemistries, CBC, ABG and anticonvulsant levels
- Seizure precautions
Post-op drug therapy

- Anticonulsant - dilantin, phenobarbital, carbamazepine
- Corticosteroids
  - Dexamethasone (decadron)
- Osmotic diuretics - mannitol
- Antibiotics, antipyretics, antiemetics
- Histamine (H2) receptor antagonist
- Analgesics
- Bowel routine
Post-op complications

- **Hemorrhage**
  - Intracranial hemorrhage- rapid increase in IICP
  - Hemorrhagic shock- usually due to blood loss in surgery, from surgical site is rare, possible GI bleeding
- **Hypovolemic shock**- results from general fluid loss, esp. if osmotic diuretics have been used
- **Cardiac arrhythmias**- not unusual, esp. after posterior fossa surgery, or is blood enters CSF
- **Cerebral edema**- major cause of IICP (HOB elevated, steroids, osmotic diuretics, possible CSF drng)
Post-op complications (cont)

- **Respiratory complications** - keep PaCO2 30-35 & PaO2 >80. At risk for aspiration due to diminished gag and swallowing reflex esp. infratentorial surgery

- **Gastric ulcer and hemorrhage** - frequent in neurology pt’s, thought to be stressed related
  - Post-op H2 Blockers

- **Seizures** - common prophylactic anticonvulsants

- **CSF leak** - most often from CSF site
  - Often will seal over spontaneously
  - Possible lumbar drain placed to keep CSF pressure low
Post-op complications (cont)

- **Meningitis** - S/S stiff neck, photophobia, restlessness and hyperirritability, elevated temp.
- **Tension pneumocephalus** - entry of air into the brain
  - Seen more in posterior fossa surgery and transphenoidal approach
  - Small amount is usually reabsorbed whereas a larger amount needs to be evacuated
- **Hydrocephalus** - rapid IICP
  - Temporary ventriculostomy or shunt
- **Electrolyte imbalance** - hyponateremia is common
Post-op complications (cont)

- Increased Intracranial Pressure- peak IICP occurs 72 hours after surgery
  - Early S/S- deterioration in LOC, pupillary dysfunction, motor weakness, sensory deficits, cranial nerve deficits, HA, seizures
  - Late S/S- continued decrease in LOC, vomiting, serve HA, hemiplegia, decortication or decerebration, changes in VS, loss of gag and/or corneal reflex, changes in RR and/or pattern
Factors known to increase ICP

- Hypercapnia and/or hypoxemia
- Resp procedures
  - suctioning, intubation, broncoscopy procedures
  - Peep increases intrathoracic pressure, increases CVP, increases cerebrovascular pressure and then IICP
- Body positioning - trendelenburg, prone, extreme hip flexion, lateral movement of neck, turning pt.
- Pressure on neck - snug trach ties, tight soft collar, tight Ett tape
Spinal Cord Tumors

- Generally occur between 20 and 60 years of age
- 60% of adult tumors are benign
- Children have a higher incidence of gliomas and sarcomas
- 1/10 as common as brain tumors (1500/year)
Locations

- Thoracic 50%
- Lumbar 25%
- Cervical 25%
- Cauda Equina 5%
- 5% of cancer patients will have spinal cord mets – most often breast, lung, or prostate in origin
Classification of Tumor Type

- Extradural (metastatic or meningioma)
- Intradural
  a) Extramedullary/Intradural – outside the cord, within the dura. (Schwannoma, Neurofibroma, or Meningioma)
  b) Intramedullary/Intradural – Within the substance of the spinal cord. (Astrocytoma, ependymoma, hemangioblastoma, epidermoids, dermoids)
Pathophysiology

- Cord Compression
- Direct Pressure
- Invasion
- Vertebral Bony Metastasis
- Tumor Progression
Diagnostics

- Spine Xrays/tomograms
- LP – contraindicated in pts with spinal cord blockage and function below the obstruction
- Myelogram
- Post myelography CT
- MRI
Clinical Presentation - Extradural

- Sx – Pain, weakness of extremities, bowel and bladder problems
- Metastatic – 10% initial symptom is spinal
Clinical Presentation – Extramedullary/Intradural

- A Schwannoma – Most common, benign, usually thoracic, may have a “hourglass” presentation, generally presents with nerve root compression, and is generally treated with complete surgical excision.
Clinical Presentation – Extramedullary/Intradural

- **Neurofibroma (Von Recklinghausen dz/ neurofibromatosis)** A benign tumor generally in the thoracic spine that may occur in multiple location. Generally presents with nerve root compression and is treated with surgical resection.
Clinical Presentation – Extramedullary/Intradural

- Meningioma – A benign tumor that occurs in the thoracic spine 60% of the time. 80% are in women 40 to 60 years old. These may be highly vascular and present with long tract signs or Brown-Sequard syndrome.
Clinical Presentation – Intramedullary/Intradural

- Astrocytoma – May be malignant- well differentiated
  M > F
  50% have a cystic component
  Sx – long tract signs, unilateral or bilateral paresis, sensory level changes, bowel or bladder problems
  Rapidly growing and requires aspiration of cystic component and bulk resection, frequently followed by radiation
Clinical Presentation – Intramedullary/Intradural

- Ependymoma – most are intramedullary and ½ occur in the cauda equina. Rarely malignant and present with pain or weakness of an extremity, local vertebral pain, radicular pain, bladder sx. Surgical resection if possible, radiation and chemo if not.
Clinical Presentation – Intramedullary/Intradural

- Hemangioblastoma – malignant but not fatal, associated with VHL dz, slow growing
  Associate with syringomyelia and syctic component
  Treat with surgical resection/radiation to retard growth
Clinical Presentation – Intramedullary/Intradural

- Epidermoids, Dermoids – congenital slow growing benign tumors that are avascular, capsulated, occurring in the lumbar spine. Are associated with spina bifida and dermal sinus tract.
Acute Neurologic Impairment

- Curative vs Palliative
- High dose steroids
- Mets – Chemo and or endocrine tx
- Surgical Intervention
- Radiation Therapy (cord tolerates 4000 to 5000 rads over 5 weeks)
- IR – Percutaneous vertebroplasty - polymethylmethacrylate injected into collapsed space
- Nsg
Pain due to Cord Compression

- Pain increases in supine position, decrease when sitting up (opposite of disc Dz), pain with vertebral palpation
- Pain meds – NSAIDS, Opioids, intrathecal, AEDs for neuropathic pain, corticosteroids, round the clock dosing
- Surgery
- Radiation (70% have relief, but delayed 2-6 wks)
- IR –
- Nsg – pain assessment, dosing, education, positioning
Alteration in Bowel Function

- Paralytic ileus and constipation
- Bowel regimen fluids, suppositories for stimulation, rectal tubes for flatus
- Nsg – assessment, education
Alteration of Urinary Elimination

- Frequent UTIs, Urinary Retention, Continuous dribbling of urine
- Check urine and appropriate ATBs
- Catheterization
- Bladder scans
- Bladder retraining
- Education
Alteration of Skin Integrity

- Assessment
- Repositioning
- Skin care
- Nutritional intake