Epidemiology of brain and spine tumors

Dr Mathangi J

38th AROI – ICRO SUN PG Teaching course
Brain Tumors

- The brain tumors – primary and secondary (metastases)
- Metastases more common – 10:1
- MC primaries - Lung, Breast, Kidney, Colorectal, Melanoma
- Primary BT rise in incidence
  i. better diagnostic ability, better
  ii. access to medical care, and better
  iii. care for the elderly
Global Incidence

- Malignant brain tumors - 4.25 cases per 100,000 person
- Regional variation 6.76 in Europe to 2.81 in Africa
- 6.29 cases per 100,000 in high income countries (HICs), to 4.81 in low and middle-income countries (LMICs).
- Malignant spinal tumors - 0.098 cases per 1,00,000 py and varied similarly by region and income group.
CBTRUS (+CDC& NCI)

- Brain tumors – 2% of all cancers
- AAAIR — 23.79 (2012 -2016) 26,070 new cases, 16947 deaths
- Malignant : non malignant - 7.08:16.71
- F:M – 1: 1.3MC BT : Males: GBM ; Females: Meningiomas
- Hispanics vs Non Hispanics: 21.48 : 24.23
  - Meningioma, Pituitary tumors, Craniopharyngioma more in blacks
  - Astrocytoma and ODG, Ependymal tumors, Embryonal tumors, Lymphoma, and GCT more in whites
Variance in Incidence

- Age: brain tumors increases with age
  - Younger: Pilocytic astrocytoma, choroid plexus tumors, neuronal tumors, pineal region tumors, and germ cell tumors
  - >65 : GBM, Meningiomas
- MBT: 5Y Survival: 33% overall (Anaplastic: 30% and GBM: 3%)
- young age, high performance status, and lower pathologic grade
- duration of symptoms, presence of cognitive alterations at diagnosis, posterior fossa location of tumor, and extent of surgical resection.
## ACS statistics 2021

### Brain and other nervous system

**AT A GLANCE**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>24,530</strong></td>
<td><strong>18,600</strong></td>
<td><strong>6.5</strong></td>
<td><strong>4.4</strong></td>
</tr>
</tbody>
</table>

- **Estimated new cases, 2021**: 24,530
- **Estimated deaths, 2021**: 18,600
- **Incidence rates, 2013-2017**: 6.5 per 100,000, age adjusted to the 2000 US standard population.
- **Death rates, 2014-2018**: 4.4 per 100,000, age adjusted to the 2000 US standard population. Rates for PR are for 2012-2016.
Distribution of All Primary Brain and Other CNS Tumors

* All or some of this histology is included in the CBTRUS definition of gliomas, including ICD-O-3 histology codes 9380–9384 and, 9391–9460 (Table 2). a. Percentages may not add up to 100% due to rounding. b. Includes oligodendroglioma and anaplastic oligodendroglioma (Table 2). c. Includes pilocytic astrocytoma, diffuse astrocytoma, anaplastic astrocytoma, and unique astrocytoma variants (Table 3). d. Includes glioma malignant, NOS, choroid plexus tumors, other neuroepithelial tumors, neuronal and mixed neuronal–glial tumors, tumors of the pineal region, other tumors of cranial and spinal nerves, mesenchymal tumors, primary melanocytic lesions, other neoplasms related to the meninges, other hematopoietic neoplasms, hemangioma, neoplasm, unspecified, and all other (Table 2).
Incidence – India - Globocon

• Brain tumors expected statistics for year 2021
• New cases: 31,460 new cases
• 26,656 deaths
• 5 year prevalence: for all ages: 5.39 per 100,000
Western vs Indian data

• Younger age at presentation - Benign:Malignant:Metastatic – 34,37,49.5 years vs 29, 63, 61 years
• GBM at earlier age (median age 50 years)
• CNS lymphoma – one decade earlier – different IHC features
• Pilocytic astrocytoma – slightly different molecular genetics
• Lower LE in developing world
  - lower geriatric age tumors > 65 years (9% vs 35%)
  - lower HGG (16% vs 23%)
  - higher pediatric tumors(35% vs 17%)
Lower intracranial tumor incidence
- MC were astrocytomas – GBMs, second MC were meningiomas
- Sellar region tumors – slightly higher
- Lesser percentage of secondaries
- MC spinal tumors were meningiomas and schwannomas
Pediatric brain tumors

- Most common solid tumors; second common after leukemias
- Slight male preponderance: 1.5:1 (cultural factors, sex hormones)
- Commonly infratentorial
  - Lowgrade astrocytomas – MC; Medulloblastoma - MC Malignant BT
  - Others being BSG and ependymoma
- In the supratentorial region:
  - Suprasellar or parasellar region: CP, optic/chiasmal/ hypothalamic gliomas
  - Pineal gland tumors and hemispheric gliomas
Challenges with PBT

- Late diagnosis/ misdiagnosis
- Damage to developing brain – treatment induced
  - Neurocognitive, Psychological, Endocrine
- Tumors carry better prognosis than their adult counterparts
- New classification incorporating molecular characteristics eg. MB
Figure 3

Distribution in Children (Ages 0–14) of Primary Brain and CNS Tumors by Histology (N = 16,044), CBTRUS, 2007–2011

- Oligoastrocytic Tumors
- Lymphoma
- Pilocytic Astrocytoma
- Embryonal Tumors
- Malignant Glioma
- All "Other" Tumors
- All "Other" Astrocytoma
- Neuronal/Mixed Neuronal-Glial
- Ependymal Tumors
- Nerve Sheath Tumors
- Craniopharyngioma
- Pituitary Tumors
- Germ Cell Tumors
- Glioblastoma
- Meningioma
- Oligodendrogliomas

- Medulloblastoma
- AT/RT
- PNET
- "Other" Embryonal
Craniopharyngioma
Astrocytoma/Glioma
Ependymoma
ATRT
Medulloblastoma

50 - 60%
15 - 20%
8 - 10%
6 - 9%
2 - 3%
10 - 15%

High-grade glioma
Low Grade Glioma: WHO I/II

40-50%

Astrocytoma/Glioma
Ependymoma
Craniopharyngioma
ATRT
Medulloblastoma
Profile of Primary Pediatric Brain and Spinal Cord Tumors from North India

Nadia Shirazi, Meenu Gupta,1 Nownee Kumar Bhat,2 Braham Prakash Kalra,2 Ranjit Kumar,3 and Manju Sain4

<table>
<thead>
<tr>
<th>Histopathological diagnosis</th>
<th>Number of cases (%)</th>
<th>Mean age (years)</th>
<th>Male:female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ewing’s sarcoma/primitive neuroectodermal tumor</td>
<td>4 (30.76)</td>
<td>12.2</td>
<td>1:3</td>
</tr>
<tr>
<td>Ependymoma</td>
<td>3 (23.07)</td>
<td>8.4</td>
<td>2:1</td>
</tr>
<tr>
<td>Glioblastoma multiforme</td>
<td>1 (7.69)</td>
<td>12</td>
<td>Female</td>
</tr>
<tr>
<td>Non-Hodgkin’s lymphoma</td>
<td>2 (15.38)</td>
<td>7.4</td>
<td>1:1</td>
</tr>
<tr>
<td>Malignant peripheral nerve sheath tumor</td>
<td>1 (7.69)</td>
<td>17</td>
<td>Male</td>
</tr>
<tr>
<td>Schwannoma</td>
<td>1 (7.69)</td>
<td>15.7</td>
<td>Male</td>
</tr>
<tr>
<td>Pilocytic astrocytoma</td>
<td>1 (7.69)</td>
<td>12</td>
<td>Female</td>
</tr>
</tbody>
</table>
Spectrum of pediatric brain tumors in India: A multi-institutional study

Ayushi Jain, Mehar C. Sharma, Vaishali Suri, Shashank S. Kale1, A. K. Mahapatra1, Medha Tatke2, Geeta Chacko2, Ashish Pathak2, Vani Santoshi2, Preeta Nair2, Nuzhat Husain1, Chitra Sarkar

Departments of Pathology and Neurosurgery, All India Institute of Medical Sciences (AIIMS), New Delhi; 2Department of...

<table>
<thead>
<tr>
<th>Tumor</th>
<th>AIIMS</th>
<th>NIMHANS</th>
<th>GB Pant</th>
<th>TMH</th>
<th>CSMMU</th>
<th>CMC Vellore</th>
<th>PGIMER</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astrocytomas</td>
<td>33.7</td>
<td>44.1</td>
<td>22.3</td>
<td>28.6</td>
<td>30.6</td>
<td>46.7</td>
<td>37</td>
<td>34.7</td>
</tr>
<tr>
<td>MB and PNETs</td>
<td>16.8</td>
<td>19.7</td>
<td>32.0</td>
<td>29.0</td>
<td>27.7</td>
<td>10.3</td>
<td>21.6</td>
<td>22.4</td>
</tr>
<tr>
<td>Cranioopharyngioma</td>
<td>12.7</td>
<td>7.7</td>
<td>13.5</td>
<td>4.5</td>
<td>13.1</td>
<td>8.5</td>
<td>11.5</td>
<td>10.2</td>
</tr>
<tr>
<td>Ependymal</td>
<td>8.5</td>
<td>8.5</td>
<td>12.2</td>
<td>10.1</td>
<td>9.4</td>
<td>4.8</td>
<td>6.3</td>
<td>9.8</td>
</tr>
<tr>
<td>Nerve sheath</td>
<td>7.0</td>
<td>4.3</td>
<td>1.3</td>
<td>2.4</td>
<td>2.2</td>
<td>4.6</td>
<td>NA</td>
<td>3.6</td>
</tr>
<tr>
<td>Meningeal</td>
<td>5.6</td>
<td>4.3</td>
<td>0.3</td>
<td>3.4</td>
<td>2.2</td>
<td>3.5</td>
<td>NA</td>
<td>3.2</td>
</tr>
<tr>
<td>Neuronal and mixed</td>
<td>4.1</td>
<td>2.9</td>
<td>5.2</td>
<td>2.1</td>
<td>0.0</td>
<td>NA</td>
<td>NA</td>
<td>2.4</td>
</tr>
<tr>
<td>Neuronal and mixed</td>
<td>2.2</td>
<td>2.2</td>
<td>3.3</td>
<td>1.7</td>
<td>2.2</td>
<td>NA</td>
<td>NA</td>
<td>2.0</td>
</tr>
<tr>
<td>Choroid plexus</td>
<td>1.5</td>
<td>2.6</td>
<td>1.6</td>
<td>1.7</td>
<td>1.5</td>
<td>NA</td>
<td>3.5</td>
<td>1.8</td>
</tr>
<tr>
<td>Pineal tumors</td>
<td>0.7</td>
<td>1.4</td>
<td>1.3</td>
<td>1.0</td>
<td>3.0</td>
<td>NA</td>
<td>NA</td>
<td>1.3</td>
</tr>
<tr>
<td>Oligodendroglioma</td>
<td>0.7</td>
<td>0.9</td>
<td>2.9</td>
<td>1.4</td>
<td>1.5</td>
<td>0.0</td>
<td>0.0</td>
<td>1.1</td>
</tr>
<tr>
<td>Lymphoma</td>
<td>1.0</td>
<td>0.5</td>
<td>0.3</td>
<td>0.0</td>
<td>1.1</td>
<td>NA</td>
<td>NA</td>
<td>0.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Astrocytomas</td>
<td>32.5</td>
<td>27.8</td>
<td>41.1</td>
<td>39.4</td>
<td>30.5</td>
<td>51.0</td>
<td>37.1</td>
<td>35.7</td>
<td>34.7</td>
</tr>
<tr>
<td>Oligodendrogliomas</td>
<td>0.9</td>
<td>2.6</td>
<td>1.1</td>
<td>1.7</td>
<td>6.2</td>
<td>0.0</td>
<td>1.7</td>
<td>0.0</td>
<td>1.1</td>
</tr>
<tr>
<td>Meningeal</td>
<td>7.4</td>
<td>8.1</td>
<td>10.4</td>
<td>7.0</td>
<td>5.6</td>
<td>8.0</td>
<td>12.0</td>
<td>4.8</td>
<td>9.8</td>
</tr>
<tr>
<td>Nerve sheath</td>
<td>3.0</td>
<td>2.2</td>
<td>3.2</td>
<td>&lt;2</td>
<td>3.1</td>
<td>1.9</td>
<td>NA</td>
<td>0.0</td>
<td>1.8</td>
</tr>
<tr>
<td>Neuronal and mixed</td>
<td>7.6</td>
<td>6.2</td>
<td>3.2</td>
<td>3.2</td>
<td>3.1</td>
<td>0.0</td>
<td>1.3</td>
<td>0.0</td>
<td>2.4</td>
</tr>
<tr>
<td>Neuronal and mixed</td>
<td>13.9</td>
<td>19.8</td>
<td>25.7</td>
<td>15.4</td>
<td>14.6</td>
<td>17.0</td>
<td>28.9</td>
<td>10.0</td>
<td>22.4</td>
</tr>
<tr>
<td>MB and PNETs</td>
<td>3.0</td>
<td>2.6</td>
<td>1.2</td>
<td>2.6</td>
<td>3.1</td>
<td>1.6</td>
<td>2.2</td>
<td>1.9</td>
<td>3.2</td>
</tr>
<tr>
<td>Choroid plexus</td>
<td>NA</td>
<td>0.4</td>
<td>NA</td>
<td>3.1</td>
<td>2.8</td>
<td>1.1</td>
<td>NA</td>
<td>0.0</td>
<td>3.6</td>
</tr>
<tr>
<td>Pineal tumors</td>
<td>3.6</td>
<td>8.1</td>
<td>3.1</td>
<td>7.9</td>
<td>1.5</td>
<td>0.9</td>
<td>14.3</td>
<td>2.0</td>
<td>14.3</td>
</tr>
<tr>
<td>Oligodendroglioma</td>
<td>11.0</td>
<td>9.2</td>
<td>4.4</td>
<td>6.8</td>
<td>18.4</td>
<td>4.6</td>
<td>6.6</td>
<td>10.5</td>
<td>10.2</td>
</tr>
<tr>
<td>Lymphoma</td>
<td>NA</td>
<td>NA</td>
<td>1.3</td>
<td>0.5</td>
<td>0.6</td>
<td>2.7</td>
<td>0.7</td>
<td>0.0</td>
<td>1.3</td>
</tr>
</tbody>
</table>
## Symptoms according to the tumor location

<table>
<thead>
<tr>
<th>Anatomic Location</th>
<th>Common Signs and Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frontal lobe</td>
<td>Personality changes, decreased motor speech (Broca’s), seizures</td>
</tr>
<tr>
<td>Temporal lobe</td>
<td>Seizures, poor memory, language comprehension (Wernicke’s)</td>
</tr>
<tr>
<td>Parietal lobe</td>
<td>Decreased sense of touch/pain, poor spatial and visual perception, poor interpretation of language</td>
</tr>
<tr>
<td>Occipital lobe</td>
<td>Poor/Loss of vision</td>
</tr>
<tr>
<td>Cerebellum</td>
<td>Ataxia, muscle movement/coordination, posture</td>
</tr>
<tr>
<td>Brainstem</td>
<td>Weakness, cranial neuropathies (III-XII), autonomic dysfunction</td>
</tr>
<tr>
<td>Thalamus</td>
<td>Weakness/motor control, consciousness, sleep/wake cycle</td>
</tr>
<tr>
<td>Hypothalamus</td>
<td>Autonomic dysfunction (temperature regulation, thirst, hunger, etc.) endocrinopathies</td>
</tr>
</tbody>
</table>
## Symptoms

<table>
<thead>
<tr>
<th>Generalized &quot;Non-Localizing&quot; Symptoms</th>
<th><strong>Increased Intracranial Pressure/Obstructive Hydrocephalus</strong></th>
<th>&quot;Localizing Symptoms&quot;</th>
<th>Endocrine Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developmental Delay</td>
<td>Headache</td>
<td>Seizures (temporal or frontal lobe tumor)</td>
<td>Diabetes Insipidus</td>
</tr>
<tr>
<td>Behavioral Changes</td>
<td>Emesis</td>
<td>Vision Changes (optic pathway or occipital lobe tumor)</td>
<td>Hypothyroidism</td>
</tr>
<tr>
<td>Decline in School Performance</td>
<td>Sleepiness/Lethargy</td>
<td>Motor Weakness (tumor in motor strip of cerebrum)</td>
<td>Weight Gain or Loss</td>
</tr>
<tr>
<td>Tiredness/Sleepiness</td>
<td>Papilledema (Vision Changes)</td>
<td>Cranial Neuropathies (brainstem tumor)</td>
<td>Panhypopituitarism</td>
</tr>
<tr>
<td></td>
<td>Full/Bulging Fontanelle</td>
<td></td>
<td>Precocious Puberty</td>
</tr>
</tbody>
</table>
Risk factors

- Radiation
- Genetics
- Head trauma
- Cell phones
- Diet, tobacco, Alcohol, Environment
- Infection/Immune system
- Allergies
Radiation

- High dose radiation
- Treatment of benign conditions/ prophylactic cranial RT
- Meningiomas or GBM
- Radiation induced tumors – mostly malignant
Genetics

• Only 5% of brain tumors
• Familial aggregation – non hereditary
• Increased incidence in first-degree relatives
• A small male gender predominance.
• “Glioma families” - pattern of inheritance remains a mystery, revealing skipped generations and inconstant times of onset.

(potential genetic etiologies or environmental risk factors - conflicting)
NF 1 & 2

1 in 3000
Chr 17
Neurofibromin restricts cell proliferation by activating (GTP) hydrolysis on ras proteins.
Multiple Neurofibromas
Fibrosarcomas, schwannomas, low grade astrocytomas - optic pathways, hypothalamus, cerebellum.

NF2 gene mutation - TS gene – AD
Chr 22 - membrane cytoskeletal protein
Merlin/ Schwannomin.
Bilateral vestibular schwannomas.
Anaplastic or atypical meningiomas
Other sporadic tumors
Von Hippel-Lindau syndrome.

- AD
- Chromosome 3p25 - tumor suppressor gene.
- Hemangioblastomas
- Pancreatic cysts
- Neuroendocrine tumors (including pheochromocytomas)
- Renal tumors.

Li Fraumeni syndrome

- AD
- Chromosome TP53 - germline mutation
- Sarcomas
- Breast cancer
- Leukemia
- Adrenocortical cancer
- all occurring before the age of 45
- Brain tumors - choroid plexus carcinomas.
Tru cot syndrome.

- An association between brain tumors and two forms of colonic polyposis – HNPCC and FAP
- HNPCC - germline mutations - MMR
- FAP -AD – mutation APC gene – Chr 5
- Majority - Medulloblastomas, - Gliomas

Blue cell nevus syndrome

- Gorlin syndrome
- Increased risk of Medulloblastoma.
- Germline mutations
- Patched 1 (PTCH1) gene
- Tumor suppressorgene.
<table>
<thead>
<tr>
<th>Condition</th>
<th>Gene Affected</th>
<th>CNS Lesion</th>
<th>Chromosome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Li-Fraumeni syndrome</td>
<td>TP53</td>
<td>Malignant glioma</td>
<td>17q</td>
</tr>
<tr>
<td>Neurofibromatosis type 1</td>
<td>NF1</td>
<td>Glioma of optic pathway/brainstem</td>
<td>17q11</td>
</tr>
<tr>
<td>Neurofibromatosis type 2</td>
<td>NF2</td>
<td>Acoustic neuroma, meningioma</td>
<td>22q12</td>
</tr>
<tr>
<td>von Hippel-Lindau syndrome</td>
<td>VHL</td>
<td>Hemangioblastoma of cerebellum/spinal cord</td>
<td>3p25</td>
</tr>
<tr>
<td>Turcot syndrome</td>
<td>APC</td>
<td>Glioblastoma, medulloblastoma</td>
<td>5q21</td>
</tr>
<tr>
<td>Gorlin syndrome</td>
<td>PTCH1</td>
<td>Medulloblastoma</td>
<td>9q22.3</td>
</tr>
</tbody>
</table>

*TP53 = tumor protein p53; NF1 = neurofibromin 1; NF2 = neurofibromin 2; VHL = von Hippel-Lindau tumor suppressor, E3 ubiquitin protein ligase; APC = adenomatous polyposis coli; PTCH1 = patched 1.*
Mobile phone use and risk of brain tumours: a systematic review of association between study quality, source of funding, and research outcomes

Manya Prasad, Prachi Kathuria, Pallavi Nair, Amit Kumar & Kameshwar Prasad

Neurological Sciences 38, 797–810 (2017) | Cite this article

Use of cell phones and brain tumors: a true association?

S. A. R. Mortazavi, Ghazal Mortazavi & S. M. J. Mortazavi

Neurological Sciences 38, 2059–2060 (2017) | Cite this article

Probabilistic Multiple-Bias Modeling Applied to the Canadian Data From the Interphone Study of Mobile Phone Use and Risk of Glioma, Meningioma, Acoustic Neuroma, and Parotid Gland Tumors


Brain tumour risk in relation to mobile telephone use: results of the INTERPHONE international case-control study

The INTERPHONE Study Group


Mobile Phones, Brain Tumors, and the Interphone Study: Where Are We Now?

Anthony J. Sweeney, Maria Feygting, Adele C. Green, Leeka Kheifets, David A. Savitz, and International Commission for Non-Ionizing Radiation Protection Standing Committee on Epidemiology

Published: 1 November 2011 | https://doi.org/10.1289/ehp.1103693 | Cited by: 67

Mobile phone use and glioma risk: A systematic review and meta-analysis

Ming Yang1, WenWen Guo2, ChunSheng Yang3, JianQin Tang1, Qian Huang2, ShouXin Feng1, AiJun Jiang1, XiFeng Xu1, Guan Jiang4

PLOS ONE | https://doi.org/10.1371/journal.pone.0175138 May 4, 2017
The World Health Organization (WHO) classified radiofrequency electromagnetic fields, such as those emitted by wireless phones, as “possibly carcinogenic to humans” (Group 2B) based on limited clinical evidence.
Occupation

- Farmers and petrochemical workers
Infections

- Viruses that induces genetic changes in cell
- Associations of infection with brain tumor - inconsistent.
- Polio vaccines contaminated with simian virus 40 (SV40) – brain tumors
- Viral antigens from JC virus and human herpes virus 6 were detected in brain tumor subtypes – but etiologic role is unclear
- Nucleic acids and proteins from CMV in GBM
Allergy

Interesting inverse relationship

Prior varicella Zoster infection – decrease risk of gliomas

decreased incidence of glioma - with a history of allergic sensitivity (asthma, eczema, or hayfever)

? Increased immune surveillance

Allergy and brain tumors in the INTERPHONE study: pooled results from Australia, Canada, France, Israel, and New Zealand

Michelle C. Turner, Daniel Krewski, Bruce K. Armstrong, Angela Chatrit, Graham G. Giles, Martine Hours, Mary L. McBride, Marie-Elise Parent, Siegal Sadetzki, Jack Siemiatycki, Alistair Woodward & Elisabeth Gardis

Cancer Causes & Control 24, 949–960 (2013) | Cite this article

Results

A significant inverse association was observed between a history of any allergy and glioma (OR = 0.73, 95% CI 0.60–0.88), meningioma (OR = 0.77, 95% CI 0.63–0.93), and acoustic neuroma (OR = 0.64, 95% CI 0.49–0.83). Inverse associations were also observed with specific allergic conditions. However, inverse associations with asthma and hay fever strengthened with increasing age of allergy onset and weakened with longer time since onset. No overall association was observed for parotid gland tumors (OR = 1.21, 95% CI 0.73–2.02).
Interesting associations

• **Physical activity** (at least 51.6 MET-h of vigorous, moderate, and/or light intensity activity per week)
• Aged 15 and 18 had reduced glioma risk (RR=0.64; 95% CI=0.44-0.93; P trend =0.02)
• Aged 19-29 – reduced risk but not significant
• Aged 35-39 – no association with the risk
• **Height:** ≥1.9 m have RR of 2.12
• **Adolescent Obesity (at 18 years):** BMI ≥ 35 (grade 3) has RR of 4.05
• Conflicting results...
Contd…

• **Head Trauma**: no associations; studies with positive results - ? Recall bias

• Diet, vitamins, alcohol, tobacco, and environmental exposures Nitrate exposure from cured meats, tobacco, pesticides, synthetic rubber, vinyl chloride, or petrochemicals – no significant associations

• Alcohol, antioxidants, fruits, vegetables – reducing risk – conflicting results
• High birth weight – associated with 2 MC brain tumors – Astrocytoma and MB/PNET.
• Higher the weight – higher the risk
  1. High birth weight - greater number of cells - in more cell divisions - vulnerability to carcinogens.
  2. Heuch et al. (for MB)- excess prenatal nutrition - interfere with the migration of granular neuronal cells (30 weeks’ gestation) - Incompletely migrated cells – immature - increased neoplastic potential.
  3. IGF-1 - key role in brain ontogenesis, carcinogenesis;
     - also in increased birthweight (maternal diabetes)
     - Astrocytoma and MB

Spinal tumors

- 3% of CNS tumors and 4% in children – 0.7 – 1.6 per 1,00,000
- Adult: >2/3 : nonmalignant.
- Childhood: Less frequent, more likely malignant; MC : Ependymoma
- Males MC: NST, ependymomas, astrocytomas; Females: Meningiomas
- Non Hispanic whites> Hispanics> non Hispanic blacks
- Mean age: 49 – 51 years

Spinal tumors

WHO classification

- Extradural - **Secondaries (MC)**
  - Primary benign: osteoma, osteoblastoma, ABC
  - Primary malignant: Myeloma/Plasmoacytoma, Chordoma, Chondrosarcoma, Osteosarcoma, Ewing’s sarcoma

- Intradural - Extramedullary(70 – 80%) – NST, Meningioma, Ependymoma
  - Intramedullary(20-30%) – Astrocytoma, Ependymoma,
    Oligodendroglioma
  - epidural hemangiomas, lipomas, extradural meningiomas, NST, lymphomas

- Indtradural: thoracic > cervical > lumbar
<table>
<thead>
<tr>
<th>Type</th>
<th>Location</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adults: Meningioma</td>
<td>Intradural–extramedullary</td>
<td>37.6</td>
</tr>
<tr>
<td>Nerve sheath tumor</td>
<td>Intradural–extramedullary</td>
<td>23.1</td>
</tr>
<tr>
<td>Ependymoma</td>
<td>Intramedullary or intradural–extramedullary</td>
<td>20.5</td>
</tr>
<tr>
<td>Astrocytoma</td>
<td>Intramedullary</td>
<td>4.2</td>
</tr>
<tr>
<td>Hemangioma</td>
<td>Intramedullary</td>
<td>3.8</td>
</tr>
<tr>
<td>Oligodendroglioma</td>
<td>Intramedullary</td>
<td>2.5</td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td>8.4</td>
</tr>
<tr>
<td>Children: Astrocytoma</td>
<td>Intramedullary</td>
<td>31.4</td>
</tr>
<tr>
<td>Ependymoma</td>
<td>Intramedullary or intradural–extramedullary</td>
<td>21.6</td>
</tr>
<tr>
<td>Oligodendroglioma</td>
<td>Intramedullary</td>
<td>16.8</td>
</tr>
<tr>
<td>Nerve sheath tumor</td>
<td>Intradural–extramedullary</td>
<td>13.3</td>
</tr>
<tr>
<td>Tumor class</td>
<td>Associated tumors</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Neuroepithelial tissue</td>
<td>Astrocytic&lt;br&gt;- Astrocytoma&lt;br&gt;- Glioblastoma&lt;br&gt;Embryonal&lt;br&gt;- Primitive neuroectodermal&lt;br&gt;- Ependymal&lt;br&gt;- Ependymoma&lt;br&gt;- Subependymoma&lt;br&gt; Mixed glioma&lt;br&gt; Neuronal and mixed neuronal-glial&lt;br&gt; - Gangliocytoma&lt;br&gt; - Gangglioma&lt;br&gt; - Ganglioneuroblastoma&lt;br&gt; Oligodendrogial&lt;br&gt; - Oligodendroglioma&lt;br&gt; Uncertain origin&lt;br&gt; - Polar spongioblastoma</td>
<td></td>
</tr>
<tr>
<td>Spinal nerves</td>
<td>Neurofibroma&lt;br&gt; Schwannoma</td>
<td></td>
</tr>
<tr>
<td>Nonmeningotheial, mesenchymal</td>
<td>Hemangioblastoma&lt;br&gt; Lipoma&lt;br&gt; Melanoma&lt;br&gt; Sarcoma</td>
<td></td>
</tr>
<tr>
<td>Germ cell tumors</td>
<td>Germinoma&lt;br&gt; Teratoma</td>
<td></td>
</tr>
<tr>
<td>Cysts and tumorlike lesions</td>
<td>Dermoid&lt;br&gt; Epidemoid</td>
<td></td>
</tr>
<tr>
<td>Hematopoietic neoplasms</td>
<td>Primary central nervous system lymphoma (microglial)</td>
<td></td>
</tr>
<tr>
<td>Metastatic tumors and other rare neoplasms</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Symptoms and signs

- Pain – localized or radiating – 72%
- Weakness – 55%
- Sensory deficits – 39%
- Sphincter dysfunction – 15%
- Bladder and bowel dysfunction: conus medullaris and filum terminale

Cauda equina nerve root compression syndrome:
- Radicular pain – anterior (L4), lateral (L5), or posterior (S1) thigh
- Muscle wasting - glutei, hamstrings, or tibialis anterior
- Saddle anaesthesia
- Absent ankle reflexes (S1), or plantar (S2) responses
- Impotence
- Loss of anal or bulbar cavernous reflexes
<table>
<thead>
<tr>
<th>Genetic disorder</th>
<th>Associated tumor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neurofibromatosis-1</td>
<td>Acute nonlymphocytic leukemias</td>
</tr>
<tr>
<td></td>
<td>Astrocytomas</td>
</tr>
<tr>
<td></td>
<td>Carcinoïd tumors</td>
</tr>
<tr>
<td></td>
<td>Hematomas</td>
</tr>
<tr>
<td></td>
<td>Hypothalamic gliomas</td>
</tr>
<tr>
<td></td>
<td>Malignant nerve sheath tumors</td>
</tr>
<tr>
<td></td>
<td>Meningiomas</td>
</tr>
<tr>
<td></td>
<td>Neurofibromas</td>
</tr>
<tr>
<td></td>
<td>Optic nerve gliomas</td>
</tr>
<tr>
<td></td>
<td>Pheochromocytomas</td>
</tr>
<tr>
<td></td>
<td>Primitive neuroectodermal tumors</td>
</tr>
<tr>
<td></td>
<td>Rhabdomyosarcomas</td>
</tr>
<tr>
<td></td>
<td>Wilms tumor</td>
</tr>
<tr>
<td>Neurofibromatosis-2</td>
<td>Bilateral acoustic schwannomas</td>
</tr>
<tr>
<td></td>
<td>Ependymomas</td>
</tr>
<tr>
<td></td>
<td>Gliomas</td>
</tr>
<tr>
<td></td>
<td>Meningiomas</td>
</tr>
<tr>
<td></td>
<td>Schwannomas</td>
</tr>
<tr>
<td>Von Hippel-Landau</td>
<td>Adrenal pheochromocytomas</td>
</tr>
<tr>
<td></td>
<td>Central nervous system hemangioblastoma (medulla oblongata or spinal cord)</td>
</tr>
<tr>
<td></td>
<td>Epididymal cystadenomas</td>
</tr>
<tr>
<td></td>
<td>Lindau tumor (cerebellum hemangioblastoma)</td>
</tr>
<tr>
<td></td>
<td>Nephritic cysts</td>
</tr>
<tr>
<td></td>
<td>Pancreatic cysts</td>
</tr>
<tr>
<td></td>
<td>Renal cell carcinomas</td>
</tr>
<tr>
<td></td>
<td>Renal cysts</td>
</tr>
<tr>
<td></td>
<td>Retinal hemangioblastomas</td>
</tr>
</tbody>
</table>
Syringomyelia
Syringomyelia

- Fluid-filled cavities in the spinal cord
- 25 to 58% of patients with IMSCT
- MC - Lower Cervical and Upper Thoracic region
- MC - Ependymomas, Hemangioblastomas, Cavernomas
- Degree of cephalad extension for a tumor and the presence of a syrinx – correlated
- 49% above, 11% below tumor level, and 40% are bipolar
- **Favorable prognostic sign** - Noninfiltrative tumors with distinct cleavage planes than more diffuse, infiltrative tumors
- Typically resolves with tumor removal
Syringomyelia – classification and etiology

(1) Alteration of cerebrospinal fluid (CSF) flow dynamics related to hindbrain disorders

(2) Intramedullary tissue damage secondary to hemorrhage or infarction – MC with Ependymomas, Hemangioblastomas, Cavernomas

(3) resulting from direct secretory ability of intramedullary tumor – increased protein levels vs CSF and non IMSCT syrinx

• DD: CSF obstruction and hindbrain disorders
  - Gardner’s “water hammer” theory
  - Williams’ “suck and slosh” theory
  - Ball and Dayan’s theory of infiltration through perivascular (Virchow-Robbin) spaces
  - Oldfield’s theory, which combines features of all of the above
Summary

• Recognizing patterns of health and diseases
• Understanding the variables that influence these patterns
• Risk factors for their occurrences
• Reasons for the outcomes
Any questions