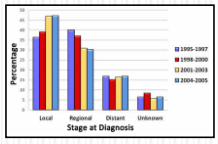
2019 Neoplasms of the BRAIN/CNS

2018-2019 FCDS Educational Webcast Series

Steven Peace, BS, CTR

March 21, 2019



CDC & Florida DOH Attribution

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FLccSC LMS – CEU Quiz –FCDS IDEA

FLccSC
Fundamental Learning Collaborative for the Cancer Surveillance Community

- 2017 - Florida Changed How FCDS Awards CEUs for FCDS Webcasts
- Attendees must take and pass a 3-5 question CEU Quiz to get CEUs
- CEU Awards are Restricted to Attendees with a FLccSC LMS Account
- The CEU Quiz will be posted to FLccSC 1-2 hours after the webcast ends

- Only registered FLccSC Users will be given access to the CEU Quiz
- Florida attendees must have a Florida FLccSC Account to take the Quiz
- South Carolina attendees must have a South Carolina FLccSC Account
- New FLccSC States will follow similar instructions for the CEU Quiz

- Attendees can attend any of the live webcasts without receiving CEUs
- Recorded Sessions are also available for non-FLccSC Users – No CEUs

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2018 - A Year for Major Changes to Cancer Registry Data Standards

- New ICD-O-3 Histology Code & Behavior Codes
- New Histology Coding Rules and Tools
- New Reportable Cancers
- **2019** Solid Tumor MP/H Rules
- 2018 Hematopoietic MP/H Rules
- Cancer Staging Updates
  - SS2018
  - Grade Coding
  - Site-Specific Data Items
  - AJCC TNM 8th ed.
  - 2018 SEER EOD
- EDITS v18
- STORE Manual
- 2018 FCDS DAM

Harmonization & Interconnectivity with Lots of Moving Parts

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2018 - A Year for Major Changes to Cancer Registry Data Standards

ICD-O-3 Third Edition - 2007 Updates for Selected Solid Tumors	https://seer.cancer.gov/icd-o-3/
ICD-O-3 Third Edition - 2010 Updates for Hematopoietic and Lymphoid Neoplasms	https://seer.cancer.gov/icd-o-3/
2018 Guidelines for ICD-O-3 Histology Code and Behavior Update	https://seer.cancer.gov/icd-o-3/
2018 Solid Tumor MP/H Coding Rules	https://seer.cancer.gov/tools/solidtumor/
2018 Hematopoietic Database & MPH Rules – web-based version only	http://seer.cancer.gov/seertools/hemelymph/
2018 SEER*Rx – current web version	http://seer.cancer.gov/seertools/seerrx/
2018 Grade Coding Manual, Instructions and Tables	https://apps.naaccr.org/ssdi/list/
2018 Summary Stage Manual	http://seer.cancer.gov/tools/ssm/
AJCC Cancer Staging Manual, 8th ed.	http://www.springer.com/medicine
AJCC Cancer Staging Manual, 8th ed. – errata & breast chapter replacement	https://cancerstaging.org/references-tools/deskreferences/Pages/8EUpdates.aspx#Histology/Topography
AJCC Histology and Topography Code Supplement	https://cancerstaging.org/references-tools/deskreferences/Pages/8EUpdates.aspx#Histology/Topography
2018 Site-Specific Data Items Manual	https://apps.naaccr.org/ssdi/list/
2018 Site/Type Validation Table from SEER	https://seer.cancer.gov/icd-o-3/
CoC STORE Manual - STandards for Oncology Registry Entry	https://www.facs.org/quality-programs/cancer/ncdb/registrymanuals/cocmanuals
SEER*SINQ - Inquiry System	https://seer.cancer.gov/seerinquiry/index.php
Coc Canswer - Inquiry System	http://cancerbulletin.facs.org/forums/
Your State EDITS Metafile – current version	https://fcds.med.miami.edu/inc/downloads.shtml

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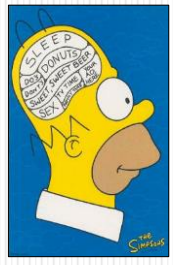
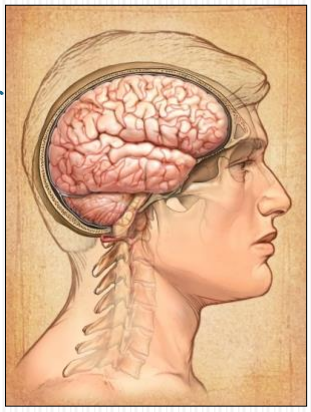
Presentation Outline

- Overview of Brain & CNS Neoplasms
- Reportable Brain & CNS Neoplasms
- Anatomy of the Human Brain & CNS
- Pediatric and Adult Brain & CNS Neoplasms
- WHO Classification for Brain and CNS Neoplasms
- **2019** Solid Tumor Rules – UPDATED from 2018
- 2018 SEER Summary Stage
- Site Specific Data Items
- Questions

Image Source: news.discovery.com



Overview



Brain Tumors are:

- **Primary "brain" tumors - those that begin in the brain *or central nervous system (or its supporting tissues)* and tend to stay in the brain - occur in people of all ages, but they are statistically more frequent in children and older adults.**

- **Metastatic "brain" tumors – those that begin as a cancer elsewhere in the body and spread to the brain – are more common in adults than in children.**

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Source: American Brain Tumor Association Facts and Statistics http://abta.org

Brain Tumors are:

- **Benign** – "Benign" brain tumors are not cancer, although they often cause symptoms and will sometimes require treatment. We prefer to use the term "non-malignant" to describe brain tumors made up of noncancerous cells.
  - Behavior = 0
  - Sequence Number = 60>
  - Reportable for Cases Diagnosed 1/1/2004 and later - only
- **Malignant** – Malignant brain tumors are cancer. They generally grow faster and more aggressively than non-malignant tumors, invade other areas of the brain and spinal cord, and can be deadly.
  - Behavior = 3 and
  - Sequence Number = 00>
  - Reportable for All Cases Regardless of Diagnosis Date
- **Borderline** – Somewhere in-between having malignant potential.
  - Behavior = 1 and
  - Sequence Number = 60>
  - Reportable for Cases Diagnosed 1/1/2004 and later - only

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Source: American Brain Tumor Association Facts and Statistics http://abta.org

Brain Tumors are:

- **Malignant primary brain and CNS tumors** are assigned **Sequence Codes in the range 00-35**
  - Sequence Chronologically 00-35
  - Only count malignant tumors in the sequence
  - If only one malignant tumor occurs, it is coded 00
  - If subsequent (multiple) primary malignant and/or in situ neoplasms, the sequence number for the first tumor begins at 01, the sequence number for the second primary tumor is 02, and so forth.
- **Non-malignant primary brain and CNS tumors** are assigned **Sequence Codes in the range 60-87**.
  - Sequence Chronologically 60-87
  - Only count benign/borderline or reportable by agreement neoplasms in the sequence
  - If only one non-malignant tumor occurs, it is coded 60.
  - If subsequent (multiple) non-malignant neoplasms are diagnosed, the first tumor should be sequenced as 61, the second 62 and so forth.

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Brain tumors are:

Characterized by Anatomic Location, Histologic Type, Behavior and WHO Tumor Grade

- **Grade I:** These are the least malignant tumors and are usually associated with long-term survival. They grow slowly and have an almost normal appearance when viewed through a microscope.
- **Grade II:** These tumors are slow growing and look slightly abnormal under a microscope. Some can spread into nearby normal tissue and recur, sometimes as a higher grade tumor.
- **Grade III:** These tumors are malignant, although there is not always a significant difference between grade II and grade III tumors. The cells of a grade III tumor are actively reproducing abnormal cells, which grow into nearby normal brain tissue. These tumors tend to recur, often as a grade IV.
- **Grade IV:** These are the most malignant tumors. They reproduce rapidly, can have a bizarre appearance when viewed under the microscope, and easily grow into nearby normal brain tissue. These tumors form new blood vessels so they can maintain their rapid growth.

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Source: American Brain Tumor Association Facts and Statistics http://abta.org

Characteristics of Brain Tumors

- Start in the brain and grow steadily there.
- Very rarely spread to other organs through the bloodstream.
- Are named for the anatomic location of tumor and/or the cells from which they arise, each having a certain function essential to normal physiological functioning of the brain.
- For example:
  - Brain Stem Gliomas arise in the lowest part of the brain.
  - Meningiomas arise in the meninges.
  - Gliomas arise from glial cells that support the CNS.
  - Astrocytomas arise from astrocytes
  - Ependymomas arise from ependymal cells which line the ventricles
  - Oligodendrogliomas arise from oligodentdrocyte cells which make up the fatty substance called myelin that covers nerves like electrical insulation.

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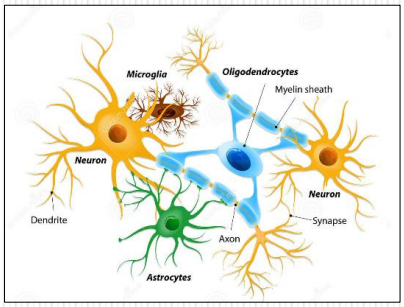
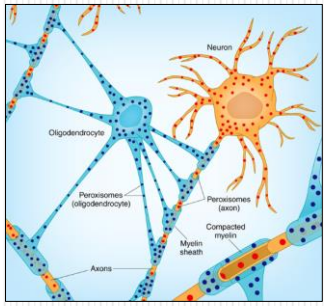
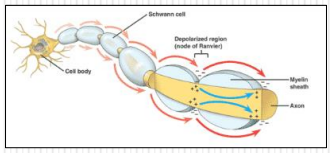
Characteristics of Brain Tumors







http://www.nature.com/ng/journal/v39/n8/images/ng0807-936-F1.jpg
http://thumbs.dreamstime.com/z/gliazellen-im-gehirn-47546395.jpg

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Range of Tumors and Symptoms

- There are over 120 different types of brain/CNS tumors.
- CNS tumors are associated with a range of symptoms and complications such as edema, seizures, endocrinopathy, fatigue, psychiatric disorder, venous thromboembolism that can seriously impact quality of life.
- Symptoms depend very much on the size and location of the tumor. General symptoms include persistent headaches which tend to be worse with activity, at night or early in the morning, convulsions, vomiting, subtle changes in personality, memory, mental ability, drowsiness, lethargy.

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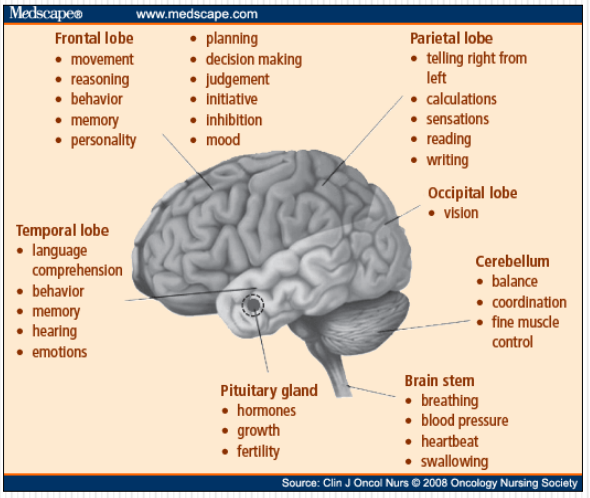
American Brain Tumor Association & SEER Training Modules

Brain Anatomy and Function



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Tumor Location and Symptoms

- Symptoms are often tumor location specific or provide clues
- Symptoms on the right side of the body may occur if the tumor is located on the left side of the brain and vice-versa.
  - The speech center in most people is on the left side of the brain. Symptoms of a tumor located here may include difficulty saying correct words while still capable of understanding what is being said.
  - If the tumor is located in the frontal lobe which controls intellectual function, thought process, behavior and memory, those activities may be affected.
- Similarity to closed head injury victims (motorcycle crash).

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ALL Brain Tumors are Reportable

- Public Law 107-260, the Benign Brain Tumor Cancer Registries Amendment Act, [PDF-185KB] requires programs participating in the National Program for Cancer Registries (NPCR) to collect data on benign and borderline tumors of the central nervous system in addition to the previously required data on malignant tumors.
- In addition to NPCR, the National Cancer Institute's (NCI) Surveillance, Epidemiology and End Results (SEER) program and the American College of Surgeons' (ACoS) Commission on Cancer began requiring that these tumors be reported, starting with cases diagnosed on January 1, 2004.

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ALL Brain Tumors are Reportable

- BUT – Do Not Report Benign/Borderline Tumors that were Diagnosed BEFORE 1/1/2004 – NOT EVEN HISTORICAL
- This creates an ERROR for FCDS at Call for Data
- FCDS then has to Delete the Case and Adjust Sequences

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ICD-O Topography Codes (Anatomic Site)

One

- Brain (C71.0 - C71.9)
- Cerebrum (C71.0)
- Frontal lobe (C71.1)
- Temporal lobe (C71.2)
- Parietal lobe (C71.3)
- Occipital lobe (C71.4)
- Ventricle (C71.5)
- Cerebellum (C71.6)
- Brain stem (C71.7)
- Overlapping lesion of the brain (C71.8)
- Brain NOS (C71.9)

- Meninges (C70.0 - C70.9)
  - Cerebral meninges (C70.0)
  - Spinal meninges (C70.1)
  - Meninges NOS (C70.9)
- Spinal cord (C72.0)
- Cauda equina (C72.1)

- Cranial nerves (C72.2 - C72.5)
  - Olfactory nerve (C72.2)
  - Optic nerve (C72.3)
  - Acoustic nerve (C72.4)
  - Cranial nerve NOS (C72.5)

- Other CNS (C72.8, C72.9)
- Pituitary gland (C75.1)
- Craniopharyngeal duct (C75.2)
- Pineal gland (C75.3)

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Clarification for Some Sites/Types

- WHO Grade I is ALWAYS a Non-Malignant Tumor
- WHO Grade 2 may be either non-malignant or malignant.
- NEW - WHO Grade Table in 2019 Solid Tumor Rules
- C710-C719 is treated as a single primary site
- No Timing Rules for Brain Tumors
- Dermoid Cyst is Reportable
- Intraspinal Tumors are Reportable
- Sphenoid Wing Meningioma arises in Cranial Meninges (C70.0)
- Intraosseous Meningioma arises in Dura of Meninges (C70.0)
- Cavernous Sinus Meningioma grown into the sinus – so, they can arise from either Cranial Meninges (C70.0) or Cranial Nerve (C72.5)
- Cavernous Sinus Hemangioma is also a reportable neoplasm (C70.0)

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Not Reportable Neoplasms

Table 4: Non-Reportable Neoplasms

Use **Table 4** for **non-malignant neoplasms ONLY**. The table identifies **histology/site** combinations which are **not reportable.** This table was created from WHO with the cooperation of the Central Brain Tumor Registry of the United States (CBTRUS).

Non-reportable Histology Term	Non-reportable Histology Code	Definitions and Sites
Carcinomas	**8010-8060, 8071-8671, 8940-8941**	Brain C710-C719 **Site/histology edit** carcinomas/brain
Carcinomas	**8010-8671, 8940-8941**	Cerebral meninges, spinal meninges, meninges NOS C700-C709 **Site/histology edit** carcinomas/meninges
Carcinomas	**8010-8671, 8940-8941**	C721-C729 (Other central nervous system) **Site/histology edit** carcinomas/other CNS
Colloid cyst	**No code**	
Epidermoid tumor/cyst	**No code**	
Glomus tympanicum, glomus jugulare	**8690/1**	These tumors occur in the inner ear, the aortic body and other paraganglia respectively; these sites are **not reportable.**
Hygroma	**9173/0**	
Hypothalamic hamartoma	**No code**	Occurs in hypothalamus
Neurofibromatosis, type 1 (NF1)	**No code***	Genetic disease that produces non-malignant tumors in the skin, brain, CNS, and other sites. The brain and CNS tumors spawned by NF1 are reportable, the genetic disease is not.
Neurofibromatosis, type 2 (NF2)	**No code***	Genetic disease that produces non-malignant tumors in the skin, brain, CNS, and other sites. The brain and CNS tumors produced by NF2 are reportable, the genetic disease is not.
Neuroglial cyst	**No code**	Ventricles
Osteochondroma	**9210/0**	Originates in the cartilage around bone, site not reportable for non-malignant neoplasms
Rathke cleft cyst	**No code**	Sella turcica C751. This is a Rathke cleft CYST, not a Rathke cleft tumor.
Schwannomatosis	**No code***	A form of neurofibromatosis newly named/discovered

***The code which is currently in ICD-O-3 for neurofibromatosis will not be used in ICD-O updates or in future ICD-O editions**

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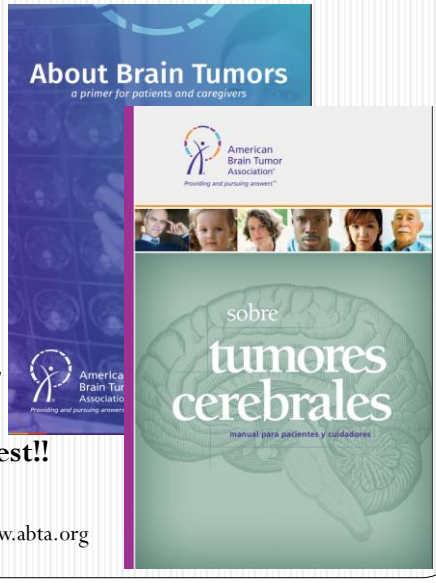
2019 Solid Tumor Rules – Brain & CNS - NonMalignant

Brain Tumor Characteristics

- **Patient Age**
- **Location**
- **Behavior**
- **Histologic Type**
- **WHO Grade of Primary Tumor**
- **Molecular Information – Newest!!**



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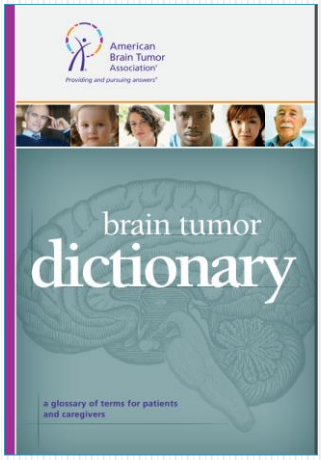
American Brain Tumor Association – http://www.abta.org

Brain Tumor Terminology



epidermoid cyst [ep ih dur´ moyd] A cyst is similar to a balloon filled with [illegible]. The cyst is usually benign, but may rarely be cancer. It cannot be removed completely. It occurs more frequently in the brain than in the spine and is most common in middle-aged adults.

epidural [ep ih dur´ al] The space between the wall of the spinal canal and the outermost covering (dura mater) of the spinal cord. An epidural injection is given into this space.

epilepsy [ep´ ill ep see] Recurrent seizures. A seizure is a sudden change in the electrical activity within the brain that causes a wide range of unusual movements, behaviors and sensations.

epithelial [ep ih thee´ lee ul] Refers to cells that line the internal and external surfaces of the body, including the skin.

equipoise [eh´ kwi poyz] Uncertainty as to whether a new treatment is effective; the rationale for investigating a new treatment.

ER Emergency Room.

ERISA Employee Retirement Income Security Act of 1974. This act governs employment or union membership benefits, including disability, health, life insurance, pension and severance.

erythema [air ih theme´ ma] Red, inflamed skin.

esophagitis [ee sof ah ji´ tiss] Inflammation of the mucous membrane in the esophagus, a sometime side-effect of chemotherapy. One form of mucositis.

estrogen receptor [ess´ tro jen] A protein found on some cells to which the hormone estrogen will attach.

etiology [ee tee ol´ o gee] The study of the cause of a disease.

evoked potentials The use of electrodes to measure the electrical activity of nerves. Can be used as a guide during surgical removal of tumors growing around important nerves.

exophytic brain stem glioma [ek so fit´ ik] A brain stem glioma that grows outward into the fourth ventricle. Symptoms are due to an increase in intracranial pressure caused by blockage of the flow of fluid from the ventricle.

external radiation Radiation therapy that uses a machine to aim high-energy rays at a cancer. *Also called external beam radiation.*

extracerebral [eks trah seh ree´ bral] Located outside the cerebral hemispheres.

extradural [eks trah du´ ral] External (outside) to the dura mater.

extramedullary [eks´ tra med´ you lair ee] "Extra" means outside. "Medulla" commonly refers to the medulla oblongata or its extension, the spinal cord. In reference to a tumor in the spine, extramedullary means that the tumor is located between the meninges and the surface of the spinal cord.

extramural research, National Cancer Institute This research is proposed and conducted by non-government scientists in laboratories and clinical facilities throughout the country. About two thirds of the NCI budget is devoted to extramural research project funding.

extrinsic brain stem glioma [ek strin´ sik • glee o´ ma] A brain stem glioma that grows out from the brain stem. These are often focal tumors and most commonly pilocytic astrocytomas or gangliogliomas.

FACE Functional Assessment of Changes in Elimination scale. A quality of life measurement tool.

FACS Fellow of the American College of Surgeons.

FACT BR A simple set of questions about a patient's quality of life. This neuropsychological instrument may be one of the tools used in evaluating a new treatment.

facial nerve 7th cranial nerve.

falx cerebri [falks • sair ee´ bry] The fold of dura mater in the fissure between the cerebral hemispheres. *Also called the falcine area* [fall seen´].

23 American Brain Tumor Association – http://www.abta.org

Common Histologic Types

- Astrocytoma, Grade I (Juvenile Pilocytic Astrocytoma)
- Astrocytoma, Grade II (Low Grade Astrocytoma)
- Astrocytoma, Grade III (Anaplastic Astrocytoma)
- Glioblastoma (Glioblastoma Multiforme/Astrocytoma, Grade IV)
- Ependymoma
- Medulloblastoma
- Meningioma
- Oligodendroglioma
- Oligoastrocytoma
- Pituitary Adenoma

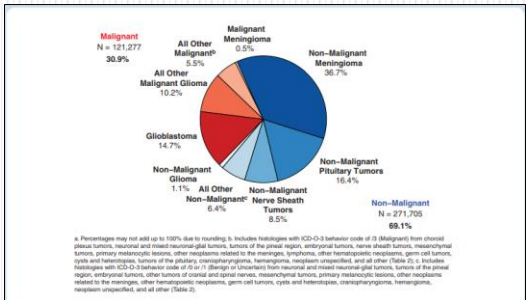


Fig. 3 Distribution[a] of Primary Brain and Other CNS Tumors by Behavior (N = 392,982), CBTRUS Statistical Report: NPCR and SEER, 2011–2015.

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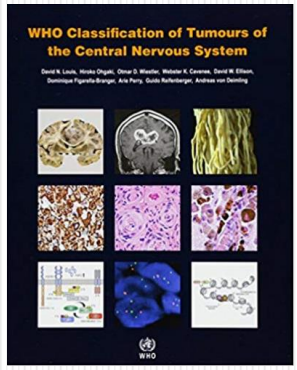
2016 WHO Classification Groups

- Diffuse Astrocytic and Oligodendroglial Tumors
- Other Astrocytic Tumors
- Ependymal Tumors
- Other Gliomas
- Neuronal and Mixed Neuronal-Glial Tumors
- Tumors of Pineal Region
- Embryonal Tumors
- Meningiomas
- Mesenchymal/non-Meningothelial Tumors
- Hematopoietic/Lymphoid Malignancies
- Germ Cell Tumors
- Tumors of the Sellar Region
- Metastatic Tumors



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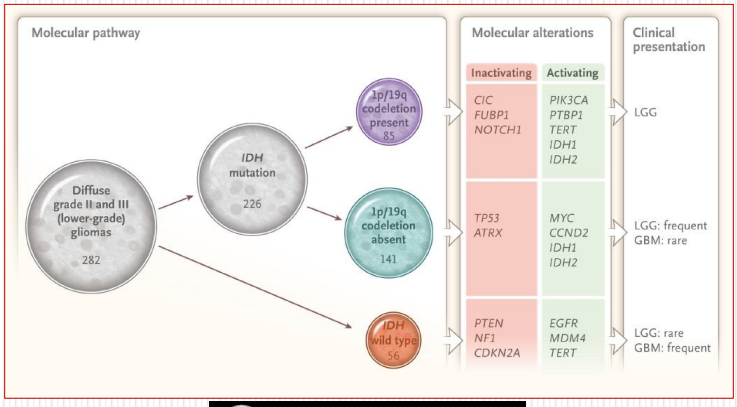
WHO Classification of Tumors of the Central Nervous System – Revised Fourth Edition

New Diagnoses are based on Combination of Histology, Behavior, Bio-molecular and Tumor Genetics Profile Plus the WHO Grade



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The NEW ENGLAND JOURNAL of MEDICINE

2016 WHO Classification Groups

- 2016 CNS WHO presents major restructuring of the diffuse gliomas, medulloblastomas and other embryonal tumors,
- And, incorporates new entities that are defined by both histology and molecular features, including glioblastoma, IDH-wildtype and glioblastoma, IDH-mutant; diffuse midline glioma, H3 K27M-mutant, RELA fusion-positive ependymoma, medulloblastoma, WNT-activated and medulloblastoma, SHH-activated, and embryonal tumor with multilayered rosettes, C19MC-altered.
- GBM subsequent to an astrocytic or glial tumor is a multiple primary. GBM is now being collected as a new primary so it is possible to analyze the frequency with which these tumors recur in a more aggressive form (GBM).

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WHO classification of tumours of the central nervous system

2016 Revision to Fourth Edition

Diffuse astrocytic and oligodendroglial tumours

Diffuse astrocytoma, IDH-mutant	9400/3
Diffuse astrocytoma, IDH-mutant	9411/3
Diffuse astrocytoma, IDH-wildtype	*9400/3*
Diffuse astrocytoma, NOS	9400/3
Anaplastic astrocytoma, IDH-mutant	9401/3
Anaplastic astrocytoma, IDH-wildtype	*9401/3*
Anaplastic astrocytoma, NOS	9401/3
Glioblastoma, IDH-wildtype	9440/3
Giant cell glioblastoma	9441/3
Gliosarcoma	9442/3
Epithelioid glioblastoma	*9440/3*
Glioblastoma, IDH-mutant	9445/3*
Glioblastoma, NOS	9440/3
Diffuse midline glioma, H3 K27M–mutant	9385/3*
Oligodendroglioma, IDH-mutant and 1p/19q-codeleted	9450/3
Oligodendroglioma, NOS	9450/3
Anaplastic oligodendroglioma, IDH-mutant and 1p/19q-codeleted	9451/3
Anaplastic oligodendroglioma, NOS	*9451/3*
Oligoastrocytoma, NOS	*9382/3*
Anaplastic oligoastrocytoma, NOS	*9382/3*

Other astrocytic tumours

Pilocytic astrocytoma	9421/1
Pilomyxoid astrocytoma	9425/3
Subependymal giant cell astrocytoma	9384/1
Pleomorphic xanthoastrocytoma	9424/3
Anaplastic pleomorphic xanthoastrocytoma	9424/3

Ependymal tumours

Subependymoma	9383/1
Myxopapillary ependymoma	9394/1
Ependymoma	9391/3
Papillary ependymoma	9393/3
Clear cell ependymoma	9391/3
Tanycytic ependymoma	9391/3
Ependymoma, *RELA* fusion-positive	9396/3*
Anaplastic ependymoma	9392/3

Other gliomas

Chordoid glioma of the third ventricle	9444/1
Angiocentric glioma	9431/1
Astroblastoma	9430/3

Choroid plexus tumours

Choroid plexus papilloma	9390/0
Atypical choroid plexus papilloma	9390/1
Choroid plexus carcinoma	9390/3

Neuronal and mixed neuronal-glial tumours

Dysembryoplastic neuroepithelial tumour	9413/0
Gangliocytoma	9492/0
Ganglioglioma	9505/1
Anaplastic ganglioglioma	9505/3
Dysplastic cerebellar gangliocytoma (Lhermitte–Duclos disease)	9493/0
Desmoplastic infantile astrocytoma and ganglioglioma	9412/1
Papillary glioneuronal tumour	9509/1
Rosette-forming glioneuronal tumour	9509/1
Diffuse leptomeningeal glioneuronal tumour	
Central neurocytoma	9506/1
Extraventricular neurocytoma	9506/1
Cerebellar liponeurocytoma	9506/1
Paraganglioma	8693/1

Tumours of the pineal region

Pineocytoma	9361/1
Pineal parenchymal tumour of intermediate differentiation	9362/3
Pineoblastoma	9362/3
Papillary tumour of the pineal region	9395/3

Embryonal tumours

Medulloblastoma, genetically defined

Medulloblastoma, WNT-activated	9475/3*
Medulloblastoma, SHH-activated and *TP53*-mutant	9476/3*
Medulloblastoma, SHH-activated and *TP53*-wildtype	9471/3
Medulloblastoma, non-WNT/non-SHH	9477/3*
Medulloblastoma, group 3	
Medulloblastoma, group 4	

Medulloblastomas, histologically defined

Medulloblastoma, classic	9470/3
Medulloblastoma, desmoplastic/nodular	9471/3
Medulloblastoma with extensive nodularity	9471/3
Medulloblastoma, large cell / anaplastic	9474/3
Medulloblastoma, NOS	9470/3
Embryonal tumour with multilayered rosettes, C19MC-altered	9478/3*
Embryonal tumour with multilayered rosettes, NOS	*9478/3*
Medulloepithelioma	9501/3
CNS neuroblastoma	9500/3
CNS ganglioneuroblastoma	9490/3
CNS embryonal tumour, NOS	9473/3
Atypical teratoid/rhabdoid tumour	9508/3
CNS embryonal tumour with rhabdoid features	*9508/3*

Tumours of the cranial and paraspinal nerves

Schwannoma	9560/0
Cellular schwannoma	9560/0
Plexiform schwannoma	9560/0
Melanotic schwannoma	9560/1
Neurofibroma	9540/0
Atypical neurofibroma	9540/0
Plexiform neurofibroma	9550/0
Perineurioma	9571/0
Hybrid nerve sheath tumours	
Malignant peripheral nerve sheath tumour	9540/3
Epithelioid MPNST	9540/3
MPNST with perineurial differentiation	9540/3

Meningiomas

Meningioma	9530/0
Meningothelial meningioma	9531/0
Fibrous meningioma	9532/0
Transitional meningioma	9537/0
Psammomatous meningioma	9533/0
Angiomatous meningioma	9534/0
Microcystic meningioma	9530/0
Secretory meningioma	9530/0
Lymphoplasmacyte-rich meningioma	9530/0
Metaplastic meningioma	9530/0
Chordoid meningioma	9538/1
Clear cell meningioma	9538/1
Atypical meningioma	9539/1
Papillary meningioma	9538/3
Rhabdoid meningioma	9538/3
Anaplastic (malignant) meningioma	9530/3

Mesenchymal, non-meningothelial tumours

Solitary fibrous tumour / haemangiopericytoma**	
Grade 1	8815/0
Grade 2	8815/1
Grade 3	8815/3
Haemangioblastoma	9161/1
Haemangioma	9120/0
Epithelioid haemangioendothelioma	9133/3
Angiosarcoma	9120/3
Kaposi sarcoma	9140/3
Ewing sarcoma / PNET	9364/3
Lipoma	8850/0
Angiolipoma	8861/0
Hibernoma	8880/0
Liposarcoma	8850/3
Desmoid-type fibromatosis	8821/1
Myofibroblastoma	8825/0
Inflammatory myofibroblastic tumour	8825/1
Benign fibrous histiocytoma	8830/0
Fibrosarcoma	8810/3
Undifferentiated pleomorphic sarcoma / malignant fibrous histiocytoma	8802/3
Leiomyoma	8890/0
Leiomyosarcoma	8890/3
Rhabdomyoma	8900/0
Rhabdomyosarcoma	8900/3
Chondroma	9220/0
Chondrosarcoma	9220/3
Osteoma	9180/0
Osteochondroma	9210/0
Osteosarcoma	9180/3

Melanocytic tumours

Meningeal melanocytosis	8728/0
Meningeal melanocytoma	8728/1
Meningeal melanoma	8720/3
Meningeal melanomatosis	8728/3

Lymphomas

Diffuse large B-cell lymphoma of the CNS	9680/3
Immunodeficiency-associated CNS lymphomas	
AIDS-related diffuse large B-cell lymphoma	
EBV-positive diffuse large B-cell lymphoma, NOS	
Lymphomatoid granulomatosis	9766/1
Intravascular large B-cell lymphoma	9712/3
Low-grade B-cell lymphomas of the CNS	
T-cell and NK/T-cell lymphomas of the CNS	
Anaplastic large cell lymphoma, ALK-positive	9714/3
Anaplastic large cell lymphoma, ALK-negative	9702/3
MALT lymphoma of the dura	9699/3

Histiocytic tumours

Langerhans cell histiocytosis	9751/3
Erdheim–Chester disease	9750/1
Rosai–Dorfman disease	
Juvenile xanthogranuloma	
Histiocytic sarcoma	9755/3

Germ cell tumours

Germinoma	9064/3
Embryonal carcinoma	9070/3
Yolk sac tumour	9071/3
Choriocarcinoma	9100/3
Teratoma	9080/1
Mature teratoma	9080/0
Immature teratoma	9080/3
Teratoma with malignant transformation	9084/3
Mixed germ cell tumour	9085/3

Tumours of the sellar region

Craniopharyngioma	9350/1
Adamantinomatous craniopharyngioma	9351/1
Papillary craniopharyngioma	9352/1
Granular cell tumour of the sellar region	9582/0
Pituicytoma	9432/1
Spindle cell oncocytoma	8290/0

Metastatic tumours

The morphology codes are from the International Classification of Diseases for Oncology (ICD-O) (142A). Behaviour is coded /0 for benign tumours; /1 for unspecified, borderline, or uncertain behaviour; /2 for carcinoma in situ and grade III intraepithelial neoplasia; and /3 for malignant tumours. The classification is modified from the previous WHO classification, taking into account changes in our understanding of these lesions. *These new codes were approved by the IARC/WHO Committee for ICD-O. *Italics*: Provisional tumour entities. **Grading according to the 2013 *WHO Classification of Tumours of Soft Tissue and Bone*.

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2016 Revision to Fourth Edition

Table 3 Major points of revision

Diffuse astrocytic and oligodendroglial tumours	Embryonal tumours
Diffuse astrocytoma, IDH mutant	Medulloblastoma, genetically defined
Gemistocytic astrocytoma, IDH mutant	Medulloblastoma, WNT activated
Diffuse astrocytoma IDH wildtype	Medulloblastoma, SHH activated, *TP53 mutated*
Diffuse astrocytoma, NOS	Medulloblastoma, SHH activated, *TP53 wildtype*
	Medulloblastoma, non-WNT/non-SHH
Anaplastic astrocytoma, IDH mutant	*Medulloblastoma, group 3*
Anaplastic astrocytoma, IDH wildtype	*Medulloblastoma, group 4*
Anaplastic astrocytoma, NOS	
	Medulloblastoma, histologically defined
Glioblastoma, IDH wildtype	Medulloblastoma, classic
Giant cell glioblastoma	Medulloblastoma, desmoplastic/nodular
Gliosarcoma	Medulloblastoma with extensive nodularity
Epithelioid glioblastoma	Medulloblastoma, large cell/anaplastic
Glioblastoma, IDH mutant	
Glioblastoma, NOS	Medulloblastoma, NOS
Diffuse midline glioma, H3-K27M mutant	*Embryonal tumour with multilayered rosettes, C19MC altered*
Oligodendroglioma, IDH mutant and 1p/19q codeleted	Embryonal tumour with multilayered rosettes, NOS
Oligodendroglioma, NOS	Medulloepithelioma
Anaplastic oligodendroglioma, IDH mutant and 1p/19q codeleted	CNS neuroblastoma
Anaplastic oligodendroglioma, NOS	CNS ganglioneuroblastoma
	CNS embryonal tumour, NOS
Oligoastrocytoma, NOS	Atypical teratoid/rhabdoid tumour
Anaplastic oligoastrocytoma, NOS	*CNS embryonal tumour with rhabdoid features*
Other astrocytic tumours	
Pilocytic astrocytoma	
Pilomyxoid astrocytoma	
Subependymal giant cell astrocytoma	
Pleomorphic xanthoastrocytoma	
Anaplastic pleomorphic xanthoastrocytoma	

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2018 NEW ICD-O-3 Histology Codes

2018 ICD-O-3 New Codes, Behaviors, and Terms-Updated 8/22/18

Status	Histology Value	Behavior	label	Reportable
New term	8720	3	Meningeal melanoma (C70._, C71._)	Y
New term	8815	0	Solitary fibrous tumor/hemangiopericytoma Grade 1 (CNS) (C71._)	Y
New term/behavior	8815	1	Solitary fibrous tumor/hemangiopericytoma Grade 2 (CNS) (C71._)	Y
New term	8815	3	Solitary fibrous tumor/hemangiopericytoma Grade 3 (CNS) (C71._)	Y
New term	9382	3	Anaplastic oligoastrocytoma (C71._)	Y
New term	9382	3	Oligoastrocytoma, NOS (C71._)	Y
New term & code	9385	3	Diffuse midline glioma, H3 K27M-mutant (C71._)	Y
New term & code	9395	3	Papillary tumor of pineal region (C75.3)	Y
New term & code	9396	3	Ependymoma, RELA fusion-positive (C71._)	Y
New term	9400	3	Diffuse astrocytoma, IDH-mutant (C71._)	Y
New term	9400	3	Diffuse astrocytoma, IDH-wildtype (C71._)	Y
New term	9401	3	Anaplastic astrocytoma, IDH-mutant (C71._)	Y
New term	9401	3	Anaplastic astrocytoma, IDH-wildtype (C71._)	Y
New term	9424	3	Anaplastic pleomorphic xanthroastrocytoma (C71._)	Y
New term & code	9425	3	Pilomyxoid astrocytoma (C71._)	Y
New term & code	9431	1	Angiocentric glioma (C71._)	Y
New term & code	9432	1	Pituicytoma (C75.1)	Y
New term	9440	3	Epithelioid glioblastoma (C71._)	Y
New term	9440	3	Glioblastoma, IDH wildtype (C71._)	Y
New term & code	9445	3	Glioblastoma, IDH-mutant (C71._)	Y
New term	9450	3	Oligodendroglioma, IDH-mutant and 1p/19q-codeleted (C71._)	Y
New term	9451	3	Anaplastic oligodendroglioma, IDH-mutant and 1p/19q codeleted (C71._)	Y
New term	9470	3	Medulloblastoma, classic (C71._)	Y
New term	9471	3	Medulloblastoma, SHH-activated and TP53-wildtype (C71._)	Y
New term & code	9475	3	Medulloblastoma, WNT-activated (C71._)	Y
New term & code	9476	3	Medulloblastoma, SHH-activated and TP53 mutant (C71._)	Y
New term & code	9477	3	Medulloblastoma, group 3 (C71._)	Y
New term & code	9477	3	Medulloblastoma, group 4 (C71._)	Y
New term & code	9477	3	Medulloblastoma, non-WNT/non-SHH (C71._)	Y
New term & code	9478	3	Embryonal tumor with multilayered rosettes C19MC-altered (C71._)	Y
New term & code	9478	3	Embryonal tumor with multilayered rosettes, NOS (C71._)	Y
New term	9508	3	CNS Embryonal tumor with rhabdoid features (C71._)	Y
New term	9508	3	Embryonal tumor with rhabdoid features (C71._)	Y
New term & code	9509	1	Diffuse leptomeningeal glioneuronal tumor (C71._)	Y
New term & code	9509	1	Papillary glioneuronal tumor (C71._)	Y
New term & code	9509	1	Rosette-forming glioneuronal tumor (C71._)	Y
New term & code	9542	3	Epithelioid malignant peripheral nerve sheath tumor (C47.0-C47.6, C47.8, C47.9)	Y
New Term	9560	1	Melanotic schwannoma (C72.4, C72.5)	Y

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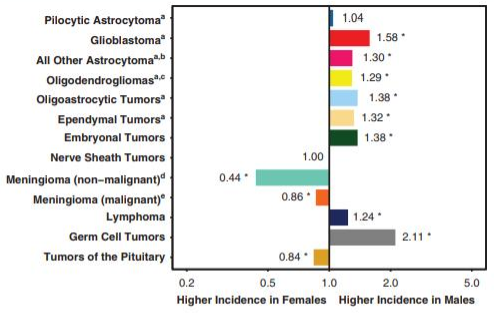
Incidence Ratios by Sex



* Incidence Rate is significantly different between groups at the p<0.05 level.
a. All or some of this histology are included in the CBTRUS definition of gliomas, including ICD-O-3 histology codes 9380-9384 and 9391-9460 (Table 2); b. ICD-O-3 histology codes: 9381, 9384, 9424, 9400, 9401, 9410, 9411, and 9420, all ICD-O-3 behavior codes; c. ICD-O-3 histology and behavior codes: 9450/3, 9451/3, and 9460/3; d. ICD-O-3 histology and behavior codes: 9530/0,9530/1, 9531/0, 9532/0, 9533/0, 9534/0, 9537/0, 9538/1, and 9539/1; e. ICD-O-3 histology and behavior codes: 9530/3, 9538/3, and 9539/3.

Fig. 10 Incidence Rate Ratios by Sex (Males:Females) for Selected CBTRUS Histology Groupings and Histology, CBTRUS Statistical Report: NPCR and SEER, 2011–2015.

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Figure 13. Most Common Brain and CNS Tumors by Age

CBTRUS Statistical Report: NPCR and SEER Data from 2004-2007

Age (yr)	Most Common Histology	Second Most Common Histology
0-4	Embryonal/medulloblastoma	Pilocytic astrocytoma
5-9	Pilocytic astrocytoma	Malignant glioma, NOS
10-14	Pilocytic astrocytoma	Neuronal/glial
15-19	Pituitary	Pilocytic astrocytoma
20-34	Pituitary	Meningioma
35-44	Meningioma	Pituitary
45-54	Meningioma	Glioblastoma
55-64	Meningioma	Glioblastoma
65-74	Meningioma	Glioblastoma
75-84	Meningioma	Glioblastoma
85+	Meningioma	Neoplasm, unspecified

While brain/CNS tumors are not one of the top incidence tumors for adults, they are the most common solid tumor in children (0-19 years) (18%) second only to leukemias (26%).
(ACS Cancer Facts and Figures 2014).

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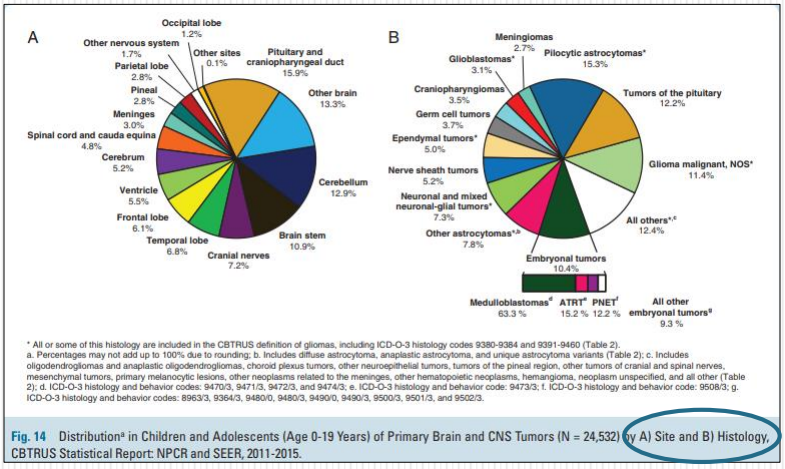
Distribution in Children/Adolescents



* All or some of this histology are 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 diffuse astrocytoma, anaplastic astrocytoma, and unique astrocytoma variants (Table 2); c. Includes oligodendroglomas and anaplastic oligodendrogliomas, choroid plexus tumors, other neuroepithelial 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); d. ICD-O-3 histology and behavior codes: 9470/3, 9471/3, 9472/3, and 9474/3; e. ICD-O-3 histology and behavior code: 9473/3; f. ICD-O-3 histology and behavior code: 9508/3; g. ICD-O-3 histology and behavior codes: 8963/3, 9364/3, 9480/0, 9480/3, 9490/0, 9490/3, 9500/3, 9501/3, and 9502/3.

Fig. 14 Distribution[a] in Children and Adolescents (Age 0-19 Years) of Primary Brain and CNS Tumors (N = 24,532) by A) Site and B) Histology, CBTRUS Statistical Report: NPCR and SEER, 2011-2015.

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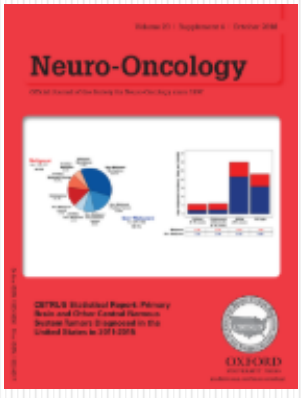
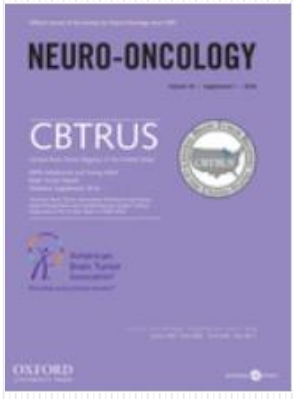
CBTRUS
CENTRAL BRAIN TUMOR REGISTRY OF THE UNITED STATES





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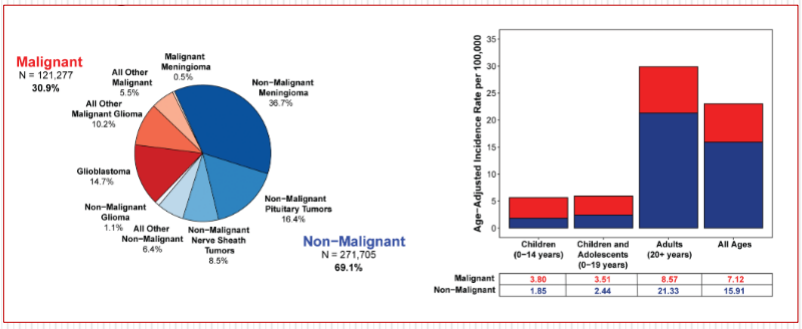
CBTRUS
CENTRAL BRAIN TUMOR REGISTRY OF THE UNITED STATES

Distribution Primary Brain & CNS Tumors 2011-2015



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CBTRUS
CENTRAL BRAIN TUMOR REGISTRY OF THE UNITED STATES

Distribution Primary Brain & CNS Tumors by Site & Behavior2011-2015

ALL

Malignant

Non-Malignant

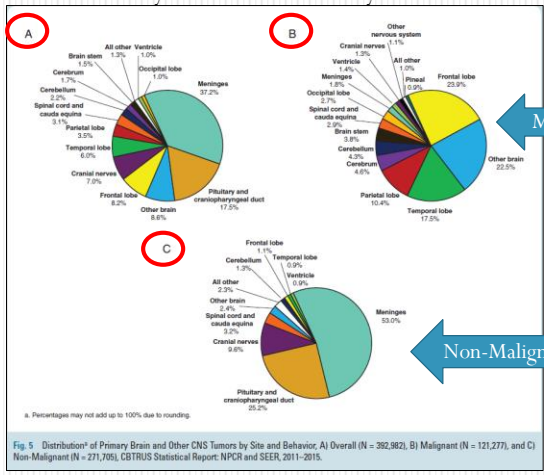

Fig. 5 Distribution[a] of Primary Brain and Other CNS Tumors by Site and Behavior, A) Overall (N = 392,982), B) Malignant (N = 121,277), and C) Non-Malignant (N = 271,705), CBTRUS Statistical Report: NPCR and SEER, 2011–2015.

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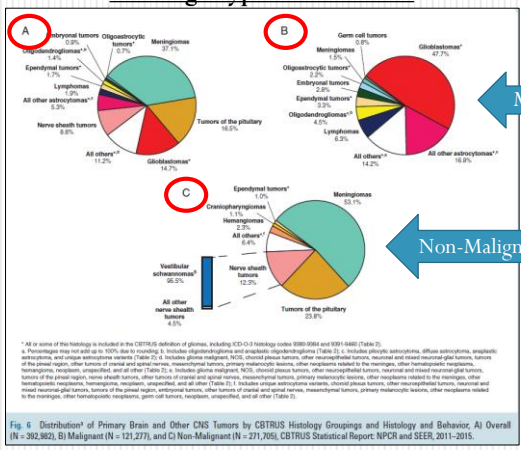
http://neuro-oncology.oxfordjournals.org/ 20(S4), 1–86, 2018 | doi:10.1093/neuonc/noy131

CBTRUS
CENTRAL BRAIN TUMOR REGISTRY OF THE UNITED STATES

Distribution Primary Brain & CNS Tumors 2011-2015

Histologic Type – All Behavior

ALL



Malignant

Non-Malignant

Fig. 6 Distribution* of Primary Brain and Other CNS Tumors by CBTRUS Histology Groupings and Histology and Behavior, A) Overall (N = 392,982), B) Malignant (N = 121,277), and C) Non-Malignant (N = 271,705), CBTRUS Statistical Report: NPCR and SEER, 2011–2015.

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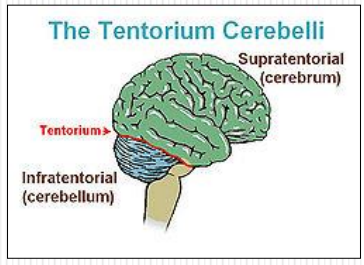
Childhood Brain Tumors

Tentorium - extension of the dura mater separating the cerebellum from the occipital lobes

- 50% of childhood brain and CNS tumors are infratentorial, originating below the tentorium
- 20+% of childhood CNS tumors are located in the sellar or suprasellar region around the sella turcica (the bone that contains the pituitary gland)
- Remainder of tumors occur in spinal cord, brain stem, cranial nerves, etc.



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Childhood Brain Tumors

Tentorium - extension of the dura mater separating the cerebellum from the occipital lobes

Note 6: The following subsites code to C710 are INFRAtentorial:

- Hypothalamus
- Pallium
- Thalamus

Note 7: The following subsites coded to C718 are SUPRAtentorial

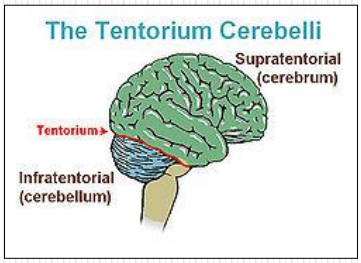
- Corpus callosum
- Tapetum

Note 8: The following sites coded to C719 are SUPRAtentorial

- Anterior cranial fossa
- Middle cranial fossa
- Suprasellar

Note 9: The following subsites coded to C719 are INFRAtentorial

- Posterior cranial fossa



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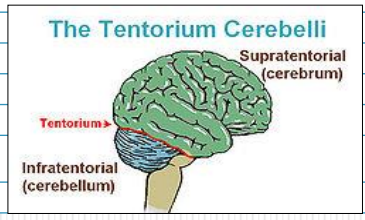
Childhood Brain Tumors

Supratentorial - childhood	Infratentorial - childhood
• Craniopharyngiomas.	• Cerebellar astrocytomas (usually high-grade).
• Diencephalic and hypothalamic gliomas.	• Medulloblastomas (primitive neuroectodermal tumors).
• Germ cell tumors.	• Ependymomas (low-grade or anaplastic).
• Low-grade astrocytomas.	• Brain stem gliomas (high-grade or low-grade).
• Anaplastic astrocytomas.	• Atypical teratoid tumors
• Glioblastoma multiforme.	
• Mixed gliomas.	
• Oligodendrogliomas.	
• Primitive neuroectodermal tumors.	
• Low-grade or anaplastic ependymomas.	
• Meningiomas.	
• Choroid plexus tumors.	



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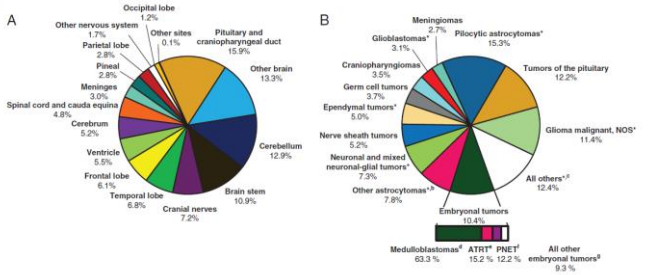
CBTRUS
CENTRAL BRAIN TUMOR REGISTRY OF THE UNITED STATES

Distribution Primary Brain & CNS Tumors 2011-2015

Children and Adolescents by Anatomic Site and Histologic Type



* All or some of this histology are 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 diffuse astrocytoma, anaplastic astrocytoma, and unique astrocytoma variants (Table 2); c. Includes oligodendrogliomas and anaplastic oligodendrogliomas, choroid plexus tumors, other neuroepithelial 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); d. ICD-O-3 histology and behavior codes: 9470/3, 9471/3, 9472/3, and 9474/3; e. ICD-O-3 histology and behavior code: 9473/3; f. ICD-O-3 histology and behavior code: 9508/3; g. ICD-O-3 histology and behavior codes: 8963/3, 9364/3, 9480/0, 9480/3, 9490/0, 9490/3, 9500/3, 9501/3, and 9502/3.

Fig. 14 Distribution[a] in Children and Adolescents (Age 0-19 Years) of Primary Brain and CNS Tumors (N = 24,532) by A) Site and B) Histology, CBTRUS Statistical Report: NPCR and SEER, 2011-2015.

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WHO Grade for Brain/CNS Tumors

- WHO Tumor Grades – Grade I, II, III, and IV
- Higher the grade – the more malignant the tumor behavior
- A tumor can contain more than one grade of cell
- Always record the highest WHO Tumor Grade noted
- WHO Grade is no longer coded in SSDI or Grade – replaced by 4 new SSDIs having to do with biomolecular genetics not WHO Grade

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http://www.abta.org/brain-tumor-information/diagnosis/grading-staging.html

WHO Grade for Brain/CNS Tumors

LOW GRADE Neoplasms

- **Grade I:** least malignant tumors associated with long-term survival. They grow slowly and have an almost normal appearance when viewed through a microscope. Surgery alone may be an effective treatment for this grade tumor.
- **Grade II:** tumors are slow-growing and look slightly abnormal under a microscope. Some can spread into nearby normal tissue and recur, sometimes as a higher grade tumor.

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http://www.abta.org/brain-tumor-information/diagnosis/grading-staging.html

WHO Grade for Brain/CNS Tumors

- **Grade III:** These tumors are, by definition, malignant although there is not always a big difference between grade II and grade III tumors. The cells of a grade III tumor are actively reproducing abnormal cells, which grow into nearby normal brain tissue. These tumors tend to recur, often as a grade IV.
- **Grade IV:** The most malignant tumors. Tumors reproduce rapidly, can have a bizarre appearance when viewed under the microscope, and easily grow into nearby normal brain tissue. These tumors form new blood vessels so they can maintain their rapid growth. They also have areas of dead cells in their centers.

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http://www.abta.org/brain-tumor-information/diagnosis/grading-staging.html

WHO Grade for Brain/CNS Tumors

WORLD HEALTH ORGANIZATION (WHO) GRADING SYSTEM

Grade I Tumor
- *Slow-growing cells*
- *Almost normal appearance under a microscope*
- *Least malignant*
- *Usually associated with long-term survival*

Grade II Tumor
- *Relatively slow-growing cells*
- *Slightly abnormal appearance under a microscope*
- *Can invade adjacent normal tissue*
- *Can recur as a higher grade tumor*

Grade III Tumor
- *Actively reproducing abnormal cells*
- *Abnormal appearance under a microscope*
- *Infiltrate adjacent normal brain tissue*
- *Tumor tends to recur, often as a higher grade*

Grade IV Tumor
- *Abnormal cells which reproduce rapidly*
- *Very abnormal appearance under a microscope*
- *Form new blood vessels to maintain rapid growth*
- *Areas of dead cells (necrosis) in center*

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http://www.abta.org/brain-tumor-information/diagnosis/grading-staging.html

Table 1: WHO Grades of Select CNS Neoplasms

Note 1: See the SEER and CoC Manuals for instructions on coding grade for CNS tumors.
Note 2: The table **does not** contain all neoplasms that may occur in the CNS.

Table Instructions
1. Use **non-malignant CNS** rules for **all WHO Grade I** (always non-malignant)
2. Go to the **malignant CNS** rules for all **WHO Grade 3 and 4**
3. Go to **Instructions for Identifying and Assigning Behavior** to determine whether **WHO Grade 2** neoplasms are non-malignant or malignant. Use the appropriate set of rules.

Column 1 contains the **histology** term
Column 2 contains the **WHO Grade** assigned **based on** the **histology** and **molecular features** of that histology

Histology	WHO Grade
Anaplastic (malignant) meningioma	3
Anaplastic astrocytoma, IDH mutant	3
Anaplastic ependymoma	3
Anaplastic ganglioglioma	3
Anaplastic oligodendroglioma IDH mutant and 1p/19q-codeleted	3
Anaplastic pleomorphic xanthroastrocytoma	3
Angiocentric glioma	1
Atypical choroid plexus papilloma	2
Atypical meningioma	2
Atypical teratoid/rhabdoid tumor	4
Central neurocytoma	2
Cerebellar liponeurocytoma	2

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2019 Solid Tumor Rules – Brain & CNS – WHO Grade Table

Histology	WHO Grade
Chordoid glioma of third ventricle	2
Choroid plexus carcinoma	3
Choroid plexus papilloma	1
CNS embryonal tumor NOS	4
CNS embryonal tumor with rhabdoid features	4
Craniopharyngioma	1
Desmoplastic infantile astrocytoma and ganglioglioma	1
Diffuse astrocytoma, IDH mutant	2
Diffuse midline glioma, H3K27M-mutant	4
Dysembryoplastic neuroepithelial tumor	1
Dysplastic gangliocytoma of cerebellum (D=Lhemitte-Duclos)	1
Ependymoma	2
Ependymoma, RELA fusion-positive *Note:* Tissue/pathology reports or CAP report will specify whether this is WHO Grade 2 or 3	2 or 3
Extraventricular neurocytoma	2
Gangliocytoma	1
Glioblastoma, IDH mutant	4
Glioblastoma, IDH wildtype	4
Granular cell tumor	1
Hemangioblastoma	1
Malignant peripheral nerve sheath tumor (MPNST) *Note:* Tissue/pathology reports or CAP report will specify whether this is WHO Grade 2, 3, or 4	2, 3, or 4
Medulloblastoma (including all subtypes)	4
Medulloepithelioma	4

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2019 Solid Tumor Rules – Brain & CNS – WHO Grade Table

Histology	WHO Grade
Meningioma	1
Myxopapillary ependymoma	1
Neurofibroma	1
Oligodendroglioma IDH mutant and 1p/19q-codeleted	2
Papillary glioneuronal tumor	1
Papillary tumor of the pineal region *Note:* Tissue/pathology report or CAP will specify whether it is WHO Grade 2 or 3	2 or 3
Perineuroma	1
Pilocytic astrocytoma *Note:* ICD-O-3 lists a behavior code of /1. US and Canada collect as /3.	1
Pineal parenchymal tumor of intermediate differentiation *Note:* Tissue/pathology or CAP synoptic report will specify WHO Grade 2 or 3	2 or 3
Pineoblastoma	4
Pineocytoma	1
Pituicytoma	1
Pleomorphic xanthroastrocytoma	2
Rosette-forming glioneuronal tumor	1
Schwannoma	1
Solitary fibrous tumor/hemangiopericytoma *Note:* Tissue/pathology will specify WHO Grade 1, 2, or 3	1, 2, or 3
Spindle cell oncocytoma	1
Subependymal giant cell astrocytoma	1
Subependymoma	1

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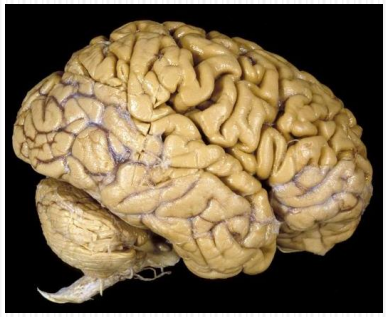
2019 Solid Tumor Rules – Brain & CNS – WHO Grade Table

ANATOMY OF THE HUMAN BRAIN



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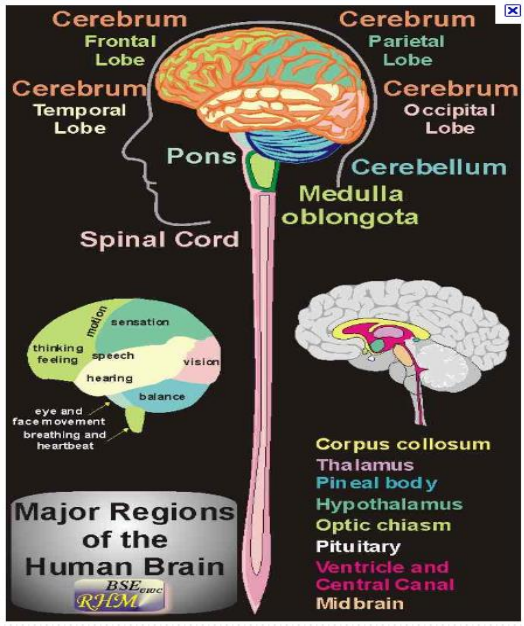
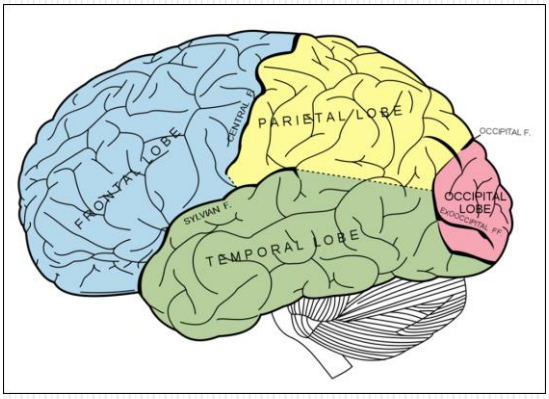
Source: National Geographic, couretsy of Fred Hossler/Getty Images



50

Source: University of Illinois

Brain Lobes and Fissures



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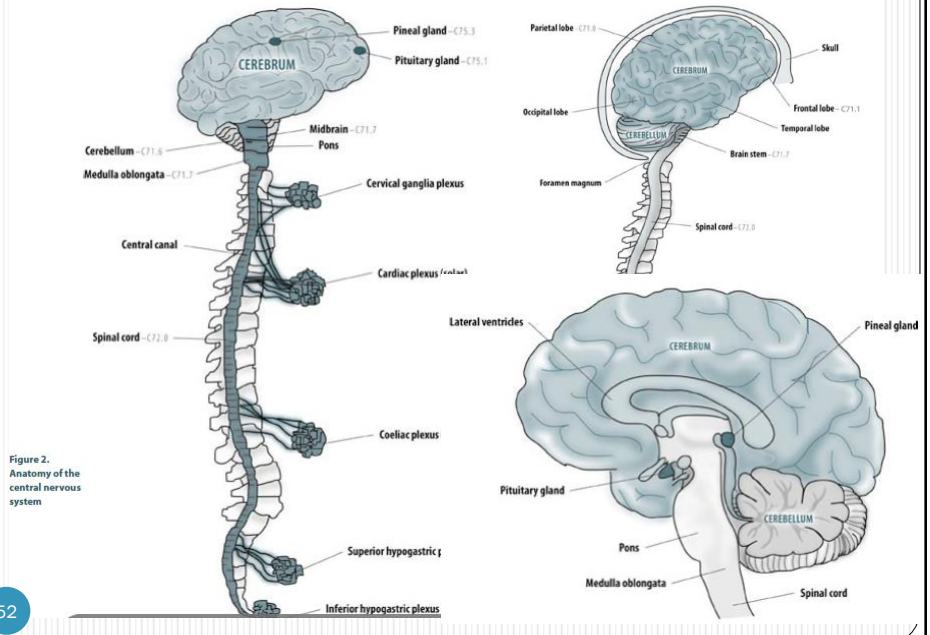

Figure 2. Anatomy of the central nervous system

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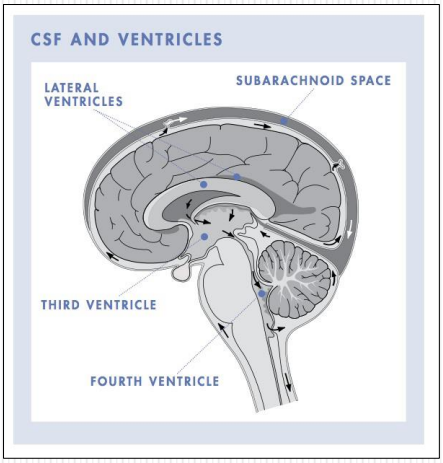
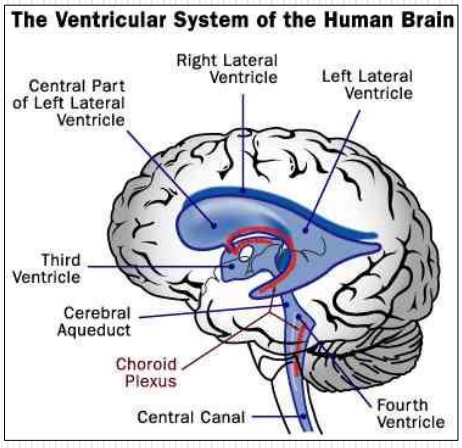
Ventricular System of the Brain



http://www.abta.org/brain-tumor-information/brain-anatomy/structure.html

53

Ventricular System of the Brain



Source: solarnavigator.net/human_brain

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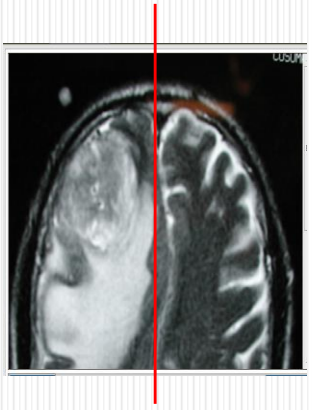
Midline Shift and Mass Effect

- The bony cranium protects the brain from outside impacts to the head. When swelling occurs in the brain, there isn't much "give".
- The swelling results in intracranial pressure and can cause a number of effects that begin to impact quality of life and comfort for the patient.
- The easiest way to describe midline shift is to bring to mind siting in a movie theater. As soon as the person to one side of you puts his elbow onto the shared armrest between you, you tend to shift away.

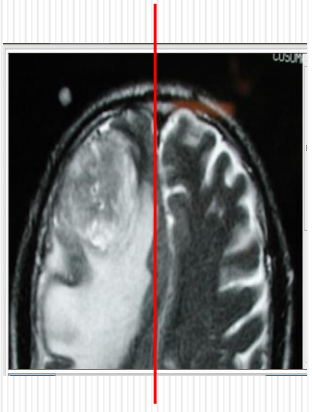


Source: Medscape

55

Midline Shift and Mass Effect

- Midline is a central boundary separating the left and right hemispheres.
- Midline Shift – Tumor crosses the brain to shift across the center line
- Mass Effect is – Edema or swelling causes the brain to shift across center line
- Both create new symptoms at cross-over
  - Depends on the size and location of he tumor and level of spread
  - Edema caused by many things
  - Either cause pushes midline out of alignment



Source: Medscape

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Meninges and Brain Stem

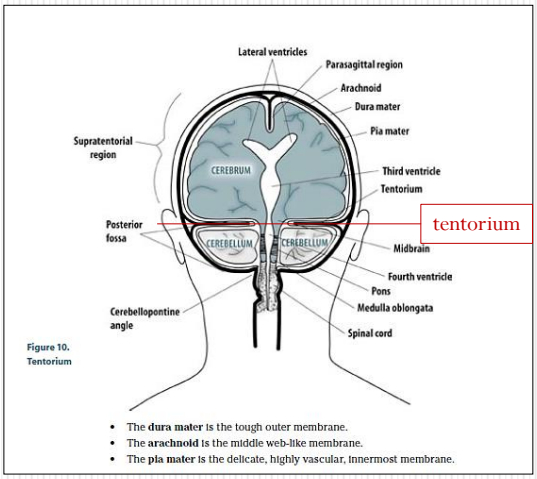
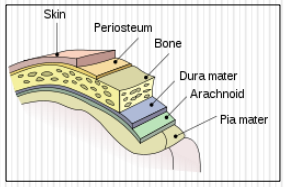
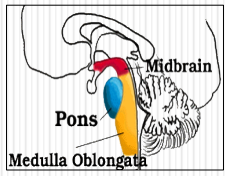


Figure 10. Tentorium

- The **dura mater** is the tough outer membrane.
- The **arachnoid** is the middle web-like membrane.
- The **pia mater** is the delicate, highly vascular, innermost membrane.





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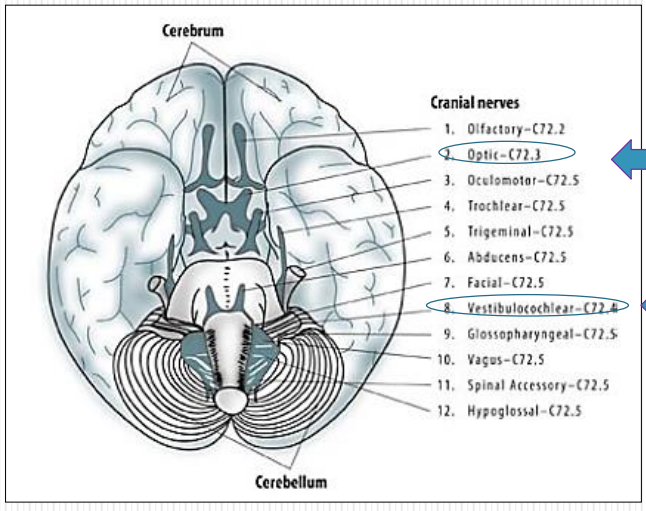
Cranial Nerves



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Cranial Nerve Functions

Cranial Nerve:	Major Functions:
I Olfactory	smell
II Optic	vision
III Oculomotor	eyelid and eyeball movement
IV Trochlear	turns eye downward and laterally, controls superior oblique muscles
V Trigeminal	chewing, face & mouth touch & pain
VI Abducens	turns eye laterally
VII Facial	facial expressions, taste, tears, saliva
VIII Vestibulocochlear	Also referred to as Auditory Nerve: hearing, equilibrium sensation
IX Glossopharyngeal	Taste, senses carotid blood pressure
X Vagus	aortic blood pressure, heart rate, stimulates digestive organs, taste
XI Spinal Accessory	controls trapezius & sternocleidomastoid muscles, controls swallowing
XII Hypoglossal	controls tongue movements

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Sinus, Olfactory, Base of Skull Tumors

- Cancer Registries treat many of these as Head & Neck Neoplasms
- Some are intra-cranial but many are not intra-cranial or CNS
- Primary Site of Tumor Critical for Stage, Treatment, and Prognosis
- Histology is used to identify which are abstracted as Brain/CNS
- Highly specialized surgical procedures – location of tumor
- Some Prognostic Factors Overlap

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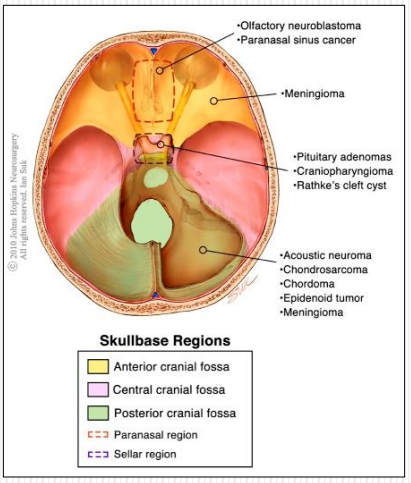
Sinus, Olfactory, Base of Skull Tumors



61

http://www.hopkinsmedicine.org/sebin/d/w/skull-base-ian-suk-sml.jpg

Histologic Type - Glioma

- Most common category of primary brain tumors. They begin in glial cells (supporting cells of the CNS) – can be Grade I-IV not just III-IV.
- Often spread into surrounding brain tissue along nerve fibers invading the spaces between nearby normal brain cells. Some invade the surrounding brain more than others.
- Difficulty obtaining complete surgical removal. MRI scans show the largest part of the glioma, but cannot reliably show areas of the brain where tumor cells have invaded. Aggressive efforts to remove small numbers of tumor cells within the brain could cause loss of neurologic function.
- When it is not possible to remove the entire glioma, post-op radiation therapy and chemotherapy may be advised.
- Even with maximum safe resection followed by radiation and chemotherapy, gliomas can grow back.

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Glioma – 3 Main Histologic SubTypes

1. Astrocytoma: In adults most often arise in the cerebrum. In children they occur in the brain stem, cerebrum and cerebellum. Rarely in brain stem in adults. Felt to be most aggressive of brain tumors.
   - Grade I and II astrocytomas are low-grade astrocytomas.
   - Grade III astrocytoma is an "anaplastic astrocytoma".
   - Grade IV astrocytoma is a "glioblastoma multiforme".

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Glioma – 3 Main Histologic SubTypes

2. Oligodendroglioma: Rare tumor that usually occurs in the cerebrum, grows slowly and usually does not spread into surrounding brain tissue like astrocytoma does. Most common in middle-aged adults.

3. Ependymoma: Most commonly arise in children and young adults. They are also seen with neurofibromatosis Type II. (which we will discuss in a bit)

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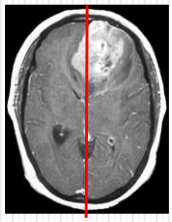
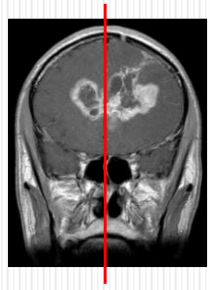
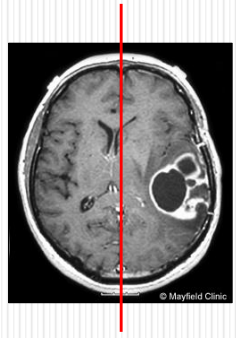
Glioma – Other Subtypes

There are other subtypes of gliomas, each with their own specific characteristics and modes of growth.

- Brain Stem Glioma
- Juvenile Pilocytic Astrocytoma
- Pleomorphic Xanthoastrocytoma
- Subependymoma
- Ganglioglioma







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Glioma Tumor Markers

Table 5 Current Molecular Biomarkers in Glioma

Biomarker	Molecular Compartment	Purpose	Analytic Validity Demonstrated	Level of Evidence	NCCN Category of Evidence	References
Markers With Accepted Clinical Utility						
1p/19q codeletion (unbalanced translocation)	Tumor DNA	Diagnostic (oligodendroglioma)	FISH, aCGH, LOH, MPLA	IA	1	Smith et al.[46]
IDH mutation (*IDH1*) c. 395 G>A p.R132H (*IDH2*)	Tumor DNA, tumor protein	Positive is favorably prognostic; also a diagnostic marker	IHC, DNA sequencing	IIB		Houillier et al.[49] Dubbink et al.[51]
MGMT methylation	Tumor DNA	Prognostic, predictive (benefit for chemotherapy), pharmacodynamic (pseudorecurrence)	MS-PCR, MS-pyrosequencing, MS-MPLA	IIB		Hegi et al.[61] Gilbert et al.[215]
Markers With Emerging Evidence						
BRAF fusion (pilocytic astrocytoma)	Tumor DNA	Diagnostic (pilocytic astrocytoma)	LDI-PCR, 5′ RACE, FISH	IIB		Jeuken and Wesseling.[216] Jones et al.[59]
CIMP (CpG island methylator phenotype)	Tumor DNA	Positive is favorably prognostic	Gene expression microarray, pyrosequencing	IIB		Noushmehr et al.[65] Gilbert et al.[215]

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Imaging/Labs/Path Reports

- In recent years, researchers have found some changes in genes, chromosomes, and proteins inside brain tumor cells that can be used to help predict a person's outlook (prognosis) or help guide treatment. Some examples of changes that can now be tested for include:
  - IDH1 or IDH2 gene mutations
  - Chromosomal 1p19q co-deletions
  - MGMT promoter methylation
- Imaging continues to improve for brain diagnosis including improvements in identifying tumor location, size, spread
  - MRI – multiple new MRI Methods (DTI, MRSI, etc.)

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2018 Site Specific Data Items

- **3801: Chromosome 1p: Loss of Heterozygosity (LOH)** - Chromosome 1p: Loss of Heterozygosity (LOH) refers to the loss of genetic material normally found on the short arm of one of the patient's two copies of chromosome 1. Codeletion of Chromosome 1p and 19q is a diagnostic, prognostic and predictive marker for gliomas and is strongly associated with the oligodendroglioma phenotype.

- **3802: Chromosome 19q: Loss of Heterozygosity (LOH)** - Chromosome 19q: Loss of Heterozygosity (LOH) refers to the loss of genetic material normally found on the long arm of one of the patient's two copies of chromosome 19. Codeletion of Chromosome 1p and 19q is a diagnostic, prognostic and predictive marker for gliomas and is strongly associated with the oligodendroglioma phenotype.

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2018 Site Specific Data Items

- **3816: Brain Molecular Markers – FCDS Required (the only FCDS Required)**
  - IDH mutation status distinguishes between clinically important subtypes within ICD-O-3 9400/3, Diffuse astrocytoma and 9401/3, Anaplastic astrocytoma.
  - IDH mutant and 1p/19q co-deletion distinguishes between clinically important subtypes within ICD-O-3 code 9450/3, Oligodendroglioma and 9451/3, Anaplastic Oligodendroglioma.
  - IDH-wildtype distinguishes clinically important subtypes within ICD-O-3 9400/3, Diffuse astrocytoma, 9401/3, Anaplastic astrocytoma and 9440/3, Glioblastoma, Epithelioidglioblastoma and Glioblastoma, NOS (note that the new ICD-O-3 code 9445/3 applies to lioblastoma, IDH-mutant; information regarding this subtype is not collected using this data item).
  - SHH-activation and TP53-wildtype distinguishes between clinically important subtypes withinICD-O-3 histology code 9471/3, Medulloblastoma.
  - C19MC alteration status distinguishes a clinically important highly aggressive subtype withinICD-O-3 9478/3, Embryonal tumor with multilayered rosettes.
- **3889: Methylation of O6-Methylguanine-Methyltransferase** - O6-Methylguanine-Methyltransferase (MGMT) is an enzyme in cells that repairs DNA. Methylation of the MGMT gene reduces production of the MGMT enzyme and the ability of tumor cells to repair damage caused by chemotherapy. Methylation of MGMT is a prognostic and predictive factor for high grade gliomas.

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Non-Glial Tumors

- Medulloblastoma: Usually arises in the cerebrum, is the most common brain tumor in children, and is sometimes called a "primitive neuroectodermal tumor" or PNET or extraosseous Ewing sarcoma.
- PNET is not neuroendocrine – it is neuroectodermal.
- Meningioma: Arises from the meninges which are the outside coverings of the brain between the skull and the brain itself. It usually presses on the brain, but does not invade it and often grows slowly.

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Meningioma

- Meningiomas are typically diagnosed by CT or MRI imaging
- Biopsy may be considered for confirmation
- Options stratified by presence/absence of symptoms and tumor size
- Most asymptomatic patients with small tumors (<30mm) may just be observed. If neurological impairment is imminent, surgery (if accessible) or radiotherapy (EBRT OR SRS) is feasible
- Asymptomatic tumors >30mm can be either resected or observed

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Non-Glial Tumors

- Schwannoma: Arises from Schwann cells present in certain nerves, including those that control balance and hearing. May be called "neuroma".
- A common site is the vestibular or auditory nerve which carries signals from the inner ear to the brain stem.
- Tumors in this location are called "acoustic neuromas" (a.k.a. vestibular schwannoma), and occur most often in adults.

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Non-Glial Tumors

- Craniopharyngioma: Grows at the base of the brain, arises from the tissue connecting the brain and the pituitary gland and occurs in both adults and children.
- Pituitary Adenoma: Arises from the pituitary gland and may cause compression of the optic nerves causing vision problems. Some produce excessive amounts of hormones that can disrupt the body's metabolism.

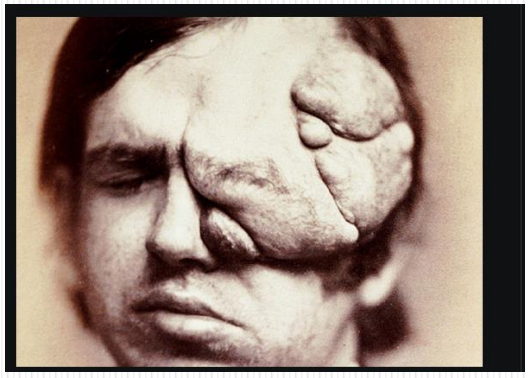
73 Roswell Park Cancer Insitute

Neurofibromatosis

- The neurofibromatoses (NF) are a group of genetic disorders which cause tumors to grow along nerves and can also affect the development of non-nervous tissues such as bones and skin.
- Neurofibromatosis Type I (NF-I), also known as Peripheral NF and historically as von Recklinghausen Disease
  - Occurs in 1:4,000 births
  - Multiple cafe-au-lait spots (not reportable)
  - Many, many neurofibromas on or under the skin (not reportable)
  - Enlargement and deformation of bones and curvature of the spine
  - Tumors may develop in brain, on cranial nerves, or the spinal cord

74 Neurofibromatosis Foundation

NF Type I: First documented photo 1871



Source Credit: Dr. Stanley B. Burns
http://www.cbsnews.com/2300-204_162-10007019-6.html#ixzz1clEzAchI

75

Other Manifestions of NF Type I

Lisch nodules on the eye

- Melanocytic hemartomas

Neurofibromatosis
lisch-nodules.jpg

Café-au-lait spots on skin

- Discolored birth marks

Neurofibromatosis
neurofibromatosis-1.jpg

76

Medscape Source: Dermnet.com; Dermatologic Manifestations of NF Type I

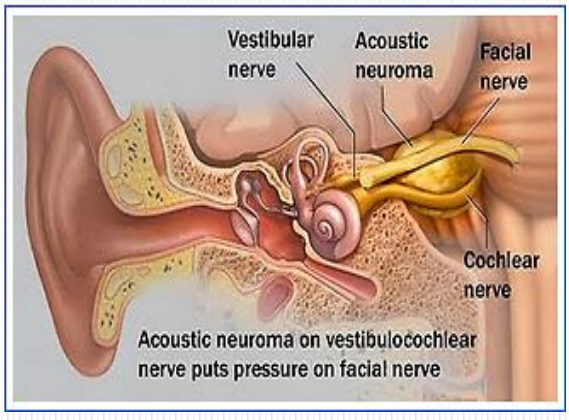
Neurofibromatosis Type II

- Neurofibromatosis Type II (NFII), also known as Multiple Inherited Schwannomas, Meningiomas and Ependymomas (MISME) or Bilateral Acoustic Neurofibromatosis (BAN).
- Is a genetically inherited diseasecaused by mutations of the "Merlin" gene, which appears to influences the form and movement of cells
- Primary manifestation is a development of non-malignant brain tumors in the region of the cranial nerves, frequently bilaterally. The eighth cranial nerve is the auditory-vestibular nerve which transmits sensory information from the inner ear to the brain and is commonly affected.

77

Source: California Ear Institute

Acoustic Neuroma/Schwannoma



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Source: http://thrivingwithneurofibromatosis.blogspot.com

2019 Solid Tumor Rules:
Non-Malignant Brain and CNS Tumors
Malignant Brain and CNS Tumors

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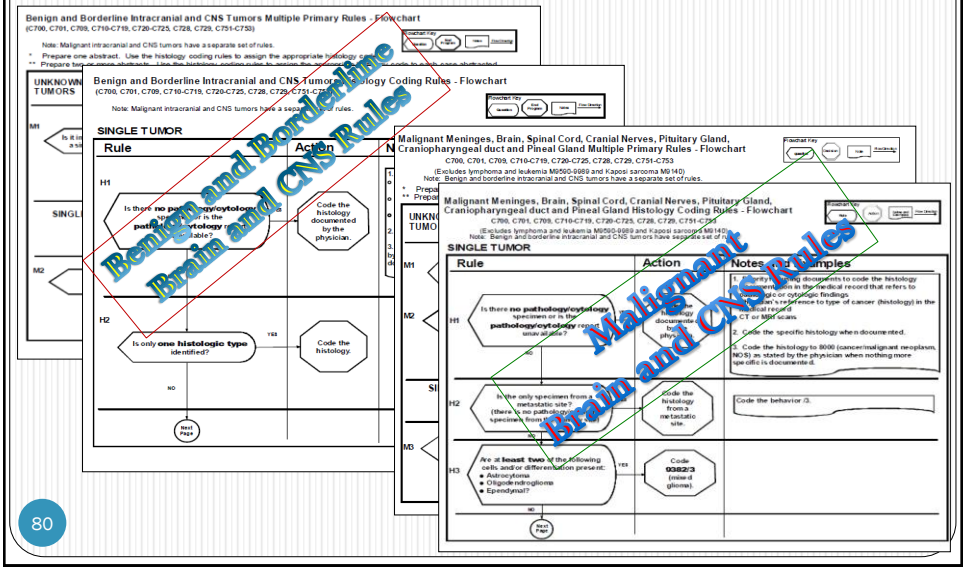
Different Rules for Benign and Malignant



80

Benign and Borderline Tumor Rules

- When multiple tumors are present registrars should identify and document specific characteristics for MPH Rules Text
  - Date of Diagnosis (Timing is not used to determine number of abstracts or primary neoplasms to abstract)
  - Method and Details of Diagnosis (some are never resected)
  - Location of Tumor
  - Bilaterality is NOT used to determine multiple primaries
    - Acoustic neuroma/vestibular schwannoma (9560/0)
    - Optic glioma/pilocytic astrocytoma (9421/1)
  - Laterality indicates multiple primaries for
    - Any lobe of the brain (C71.0-C71.9) and any other part of CNS
    - Cerebral meningioma (9530/0) and Spinal meningioma (9530/0)
    - Cranial Nerves and other Parts of CNS
  - Laterality is NOT used to determine multiple primaries when all are in the cranial meninges
  - Histologic Type – refer to Tables in Module
  - Tumor Behavior
  - Neurofibromatosis Characteristics (when applicable)

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Benign and Borderline Tumor Rules

Table 6: Specific Histologies, NOS, and Subtypes/Variants

Use this table to identify **reportable** histologies, **including specific, NOS,** and the **subtype/variant** of that NOS when referenced in the Multiple Primary and Histology coding rules.

This table includes the more common non-malignant histologies which occur in the CNS.

Column 1 contains specific and NOS histology terms.
- **Specific** histology terms **do not** have **subtypes/variants**
- **NOS** histology terms **do** have **subtypes/variants.**

Column 2 contains **synonyms** for the specific or NOS term. Synonyms have the **same** histology **code** as the specific or NOS term.
Column 3 contains **subtypes/variants** of the **NOS** histology. Subtypes/variants **do not** have the **same** histology code as the NOS term.

NOS/Specific Histology Term and Code	Synonyms	Subtypes/Variants Histology Term and Codes
Angiocentric glioma 9431/1*	Angiocentric neuroepithelial tumor Monomorphous angiocentric glioma	
Benign fibrous histiocytoma 8830/0		
Central neurocytoma 9506/1	Cerebellar liponeurocytoma Extraventricular neurocytoma	
Chondroma 9220/0		
Chordoid glioma of the third ventricle 9444/1		
Choroid plexus papilloma 9390/0		Atypical choroid plexus papilloma **9390/1**
Craniopharyngioma 9350/1		Adenomatous craniopharyngioma **9351/1** Papillary craniopharyngioma **9352/1**

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Benign and Borderline Tumor Rules

NOS/Specific Histology Term and Code	Synonyms	Subtypes/Variants Histology Term and Codes
Desmoplastic infantile astrocytoma and ganglioglioma 9412/1		
Dysembryoplastic neuroepithelial tumor 9413/0	DNT	
Gangliocytoma 9492/0		Dysplastic cerebellar gangliocytoma/Lhermitte-Duclos disease **9493/0**
Ganglioglioma 9505/1		
Granular cell tumor of the sellar region 9582/0		
Hemangioblastoma 9161/1	Capillary hemangioblastoma	
Hemangioma 9120/0		
Leiomyoma 8890/0		
Lipoma 8850/0		Hibernoma **8880/0**
Meningeal melanocytosis 8728/0		Meningeal melanocytoma **8728/1**
Meningioma 9530/0	Lymphoplasmacyte-rich meningioma Metaplastic meningioma Microcystic meningioma Secretory meningioma	Angiomatous meningioma **9534/0** Atypical meningioma **9539/1** Clear cell/chordoid meningioma **9538/1** Fibrous meningioma **9532/0** Meningothelial meningioma **9531/0** Psammomatous meningioma **9533/0** Transitional meningioma **9537/0**
Myofibroblastoma 8825/0		Inflammatory myofibroblastic tumor **8825/1**
Myxopapillary ependymoma 9394/1		
Neurofibroma 9540/0	Atypical neurofibroma	Plexiform neurofibroma **9550/0**
Optic glioma/pilocytic astrocytoma 9421/1		
Osteoma 9180/0		

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Tumors with Potential to Transform

Table 8: Non-Malignant CNS Tumors with the Potential of Transforming to Malignant Behavior

The word "**transformation**" as used in this table means that:

- Residual tumor becomes more aggressive /3 **OR**
- The tumor **recurs** as a **more aggressive /3 histology**

The table identifies non-malignant tumors that have the **potential** of **transforming to** a malignant tumor (**new primary**).

Column 1 is the **non-malignant** ICD-O histology term and code.
Column 2 is the **malignant** /3 ICD-O histology term and code to which the non-malignant tumor can transform.

Original Histology and Code	Transformed Histology and Code
Chondroma **9220/0**	Chondrosarcoma **9220/3**
Ganglioglioma **9505/1**	Anaplastic ganglioglioma **9505/3**
Hemangioma **9120/0**	Angiosarcoma **9120/3**
Hemangiopericytoma **9150/1**	Anaplastic hemangiopericytoma **9150/3**
Leiomyoma **8890/0**	Leiomyosarcoma **8890/3**
Lipoma **8850/0**	Liposarcoma **8850/3**
Osteoma **9180/0**	Osteosarcoma **9180/3**
Perineurioma **9571/0**	Malignant perineurioma **9571/3**
Rhabdomyoma **8900/0**	Rhabdomyosarcoma **8900/3**
Teratoma **9080/1**	Immature teratoma **9080/3**
Teratoma, mature **9080/0**	Immature teratoma **9080/3**

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Malignant Tumor Rules

- 2016 CNS WHO presents major restructuring of the diffuse gliomas, medulloblastomas and other embryonal tumors,
- And, incorporates new entities that are defined by both histology and molecular features, including glioblastoma, IDH-wildtype and glioblastoma, IDH-mutant; diffuse midline glioma, H3 K27M-mutant, RELA fusion-positive ependymoma, medulloblastoma, WNT-activated and medulloblastoma, SHH-activated, and embryonal tumor with multilayered rosettes, C19MC-altered.
- GBM subsequent to an astrocytic or glial tumor is a multiple primary. GBM is now being collected as a new primary so it is possible to analyze the frequency with which these tumors recur in a more aggressive form (GBM).

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WHO Grade for Brain/CNS Tumors

- WHO Tumor Grades – Grade I, II, III, and IV
- Higher the grade – the more malignant the tumor behavior
- A tumor can contain more than one grade of cell
- Always record the highest WHO Tumor Grade noted
- WHO Grade is no longer coded in SSDI or Grade – replaced by 4 new SSDIs having to do with biomolecular genetics not WHO Grade

http://www.abta.org/brain-tumor-information/diagnosis/grading-staging.html

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WHO Grade for Brain/CNS Tumors

LOW GRADE Neoplasms

- **Grade I:** least malignant tumors associated with long-term survival. They grow slowly and have an almost normal appearance when viewed through a microscope. Surgery alone may be an effective treatment for this grade tumor.
- **Grade II:** tumors are slow-growing and look slightly abnormal under a microscope. Some can spread into nearby normal tissue and recur, sometimes as a higher grade tumor.

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http://www.abta.org/brain-tumor-information/diagnosis/grading-staging.html

WHO Grade for Brain/CNS Tumors

- **Grade III:** These tumors are, by definition, malignant although there is not always a big difference between grade II and grade III tumors. The cells of a grade III tumor are actively reproducing abnormal cells, which grow into nearby normal brain tissue. These tumors tend to recur, often as a grade IV.
- **Grade IV:** The most malignant tumors. Tumors reproduce rapidly, can have a bizarre appearance when viewed under the microscope, and easily grow into nearby normal brain tissue. These tumors form new blood vessels so they can maintain their rapid growth. They also have areas of dead cells in their centers.

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http://www.abta.org/brain-tumor-information/diagnosis/grading-staging.html

WHO Grade for Brain/CNS Tumors

WORLD HEALTH ORGANIZATION (WHO) GRADING SYSTEM

Grade I Tumor
- *Slow-growing cells*
- *Almost normal appearance under a microscope*
- *Least malignant*
- *Usually associated with long-term survival*

Grade II Tumor
- *Relatively slow-growing cells*
- *Slightly abnormal appearance under a microscope*
- *Can invade adjacent normal tissue*
- *Can recur as a higher grade tumor*

Grade III Tumor
- *Actively reproducing abnormal cells*
- *Abnormal appearance under a microscope*
- *Infiltrate adjacent normal brain tissue*
- *Tumor tends to recur, often as a higher grade*

Grade IV Tumor
- *Abnormal cells which reproduce rapidly*
- *Very abnormal appearance under a microscope*
- *Form new blood vessels to maintain rapid growth*
- *Areas of dead cells (necrosis) in center*

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http://www.abta.org/brain-tumor-information/diagnosis/grading-staging.html

Table 1: WHO Grades of Select CNS Neoplasms

Note 1: See the SEER and CoC Manuals for instructions on coding grade for CNS tumors.
Note 2: The table **does not** contain all neoplasms that may occur in the CNS.

Table Instructions
1. Use **non-malignant CNS** rules for **all WHO Grade I** (always non-malignant)
2. Go to the **malignant CNS** rules for all **WHO Grade 3 and 4**
3. Go to **Instructions for Identifying and Assigning Behavior** to determine whether **WHO Grade 2** neoplasms are non-malignant or malignant. Use the appropriate set of rules.

Column 1 contains the **histology** term
Column 2 contains the **WHO Grade** assigned **based on** the **histology** and **molecular features** of that histology

Histology	WHO Grade
Anaplastic (malignant) meningioma	3
Anaplastic astrocytoma, IDH mutant	3
Anaplastic ependymoma	3
Anaplastic ganglioglioma	3
Anaplastic oligodendroglioma IDH mutant and 1p/19q-codeleted	3
Anaplastic pleomorphic xanthroastrocytoma	3
Angiocentric glioma	1
Atypical choroid plexus papilloma	2
Atypical meningioma	2
Atypical teratoid/rhabdoid tumor	4
Central neurocytoma	2
Cerebellar liponeurocytoma	2

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2019 Solid Tumor Rules – Brain & CNS – WHO Grade Table

Histology	WHO Grade
Chordoid glioma of third ventricle	2
Choroid plexus carcinoma	3
Choroid plexus papilloma	1
CNS embryonal tumor NOS	4
CNS embryonal tumor with rhabdoid features	4
Craniopharyngioma	1
Desmoplastic infantile astrocytoma and ganglioglioma	1
Diffuse astrocytoma, IDH mutant	2
Diffuse midline glioma, H3K27M-mutant	4
Dysembryoplastic neuroepithelial tumor	1
Dysplastic gangliocytoma of cerebellum (D=Lhemitte-Duclos)	1
Ependymoma	2
Ependymoma, RELA fusion-positive *Note:* Tissue/pathology reports or CAP report will specify whether this is WHO Grade 2 or 3	2 or 3
Extraventricular neurocytoma	2
Gangliocytoma	1
Glioblastoma, IDH mutant	4
Glioblastoma, IDH wildtype	4
Granular cell tumor	1
Hemangioblastoma	1
Malignant peripheral nerve sheath tumor (MPNST) *Note:* Tissue/pathology reports or CAP report will specify whether this is WHO Grade 2, 3, or 4	2, 3, or 4
Medulloblastoma (including all subtypes)	4
Medulloepithelioma	4

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2019 Solid Tumor Rules – Brain & CNS – WHO Grade Table

Histology	WHO Grade
Meningioma	1
Myxopapillary ependymoma	1
Neurofibroma	1
Oligodendroglioma IDH mutant and 1p/19q-codeleted	2
Papillary glioneuronal tumor	1
Papillary tumor of the pineal region *Note:* Tissue/pathology report or CAP will specify whether it is WHO Grade 2 or 3	2 or 3
Perineuroma	1
Pilocytic astrocytoma *Note:* ICD-O-3 lists a behavior code of /1. US and Canada collect as /3.	1
Pineal parenchymal tumor of intermediate differentiation *Note:* Tissue/pathology or CAP synoptic report will specify WHO Grade 2 or 3	2 or 3
Pineoblastoma	4
Pineocytoma	1
Pituicytoma	1
Pleomorphic xanthroastrocytoma	2
Rosette-forming glioneuronal tumor	1
Schwannoma	1
Solitary fibrous tumor/hemangiopericytoma *Note:* Tissue/pathology will specify WHO Grade 1, 2, or 3	1, 2, or 3
Spindle cell oncocytoma	1
Subependymal giant cell astrocytoma	1
Subependymoma	1

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2019 Solid Tumor Rules – Brain & CNS – WHO Grade Table

Malignant Tumor Rules

Specific and NOS Histology Codes	Synonyms	Subtypes/Variants
Anaplastic ganglioglioma **9505**		
Astroblastoma **9430**		
Astrocytoma NOS **9400**	Diffuse astrocytoma IDH-mutant Diffuse astrocytoma IDH-wildtype Diffuse astrocytoma NOS	Anaplastic astrocytoma IDH-mutant/wildtype; anaplastic astrocytoma NOS **9401** Gemistocytic astrocytoma IDH-mutant **9411** Pleomorphic xanthroastrocytoma /anaplastic pleomorphic xanthroastrocytoma **9424**
Choriocarcinoma **9100**		
Choroid plexus carcinoma **9390**		
CNS embryonal tumor with rhabdoid features **9508**	Atypical teratoid/rhabdoid tumor Embryonal tumor with rhabdoid features	
CNS ganglioneuroblastoma **9490**		CNS embryonal tumor **9473**
CNS neuroblastoma **9500**		
Diffuse midline glioma H3 K27M mutant **9385***		
Embryonal carcinoma **9070**		Yolk sac tumor **9071**
Embryonal tumor with multilayered rosettes C19MC-altered **9478***	Embryonal tumor with multilayered rosettes, NOS ETMR	
Ependymoma **9391**	Clear cell ependymoma Tanycytic ependymoma	Anaplastic ependymoma **9392** Ependymoma, RELA fusion-positive **9396*** Papillary ependymoma **9393**
Epithelioid hemangioendothelioma **9133**		
Germinoma **9064**		

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Malignant Tumor Rules

Specific and NOS Histology Codes	Synonyms	Subtypes/Variants
Oligodendroglioma NOS **9450** *Note:* Oligodendroglioma NOS is used when molecular markers cannot fully be determined	Oligodendroglioma 1p/19q-codeleted Oligodendroglioma IDH-mutant Oligodendroglioma IDH-mutant and 1p/19q-codeleted	Anaplastic oligodendroglioma NOS **9451** IDH-mutant 1p/19q-codeleted IDH-mutant and 1p/19q-codeleted
Peripheral primitive neuroectodermal tumor **9364**	Ewing sarcoma PpNET	
Pilocytic astrocytoma **9421** *Note:* ICD-O-3 lists a behavior code of /1. It is collected as /3 in North America.		Pilomyxoid astrocytoma **9425**
Pineal parenchymal tumor of intermediate differentiation **9362**	Pineoblastoma	Papillary tumor of the pineal region **9395**
Sarcoma NOS **8800** *Note 1:* **Chondrosarcoma 9220** has the following subtype/variant: Mesenchymal chondrosarcoma **9240** *Note 2:* **Leiomyosarcoma 8890** has the following subtypes/variants: Epithelioid leiomyosarcoma **8891** Myxoid leiomyosarcoma **8896**		Angiosarcoma **9120** Chondrosarcoma **9220** Mesenchymal chondrosarcoma **9240** Leiomyosarcoma/granular cell leiomyosarcoma/inflammatory leiomyosarcoma **8890** Epithelioid leiomyosarcoma **8891** Myxoid leiomyosarcoma **8896** Osteosarcoma **9180** Undifferentiated pleomorphic sarcoma/malignant fibrous histiocytoma **8802**
Solitary fibrous tumor grade 3 **8815**	Hemangiopericytoma grade 3 Solitary fibrous tumor/Hemangiopericytoma grade 3 (CNS)	

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Malignant Tumor Rules

- When multiple tumors are present registrars should identify and document specific characteristics for MPH Rules Text
  - Non-malignant intracranial and CNS tumors have separate sets of rules
  - Laterality is not used to determine multiple primaries for CNS tumors
  - Date of Diagnosis (Timing is not used to determine number of abstracts or primary neoplasms to abstract)
  - Method and Details of Diagnosis (most attempt resection)
  - Location of Tumor (not spread or invasion – but bulk of tumor)
  - Histologic Type /Subtype or Combination – Table 3
  - GBM subsequent to an astrocytic or glial tumor is a multiple primary. GBM is now being collected as a new primary so it is possible to analyze the frequency with which these tumors recur in a more aggressive form (GBM). M

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Malignant Tumor Rules

Rule H4 Code the **subtype/variant** when there is a **NOS** and a **single subtype/variant** of that NOS such as the following:
Note: All tumors are malignant/invasive /3.

- Astrocytoma **9400** and a subtype/variant of astrocytoma
- CNS ganglioneuroblastoma **9490** and a subtype/variant of CNS ganglioneuroblastoma
- Embryonal carcinoma **9070** and a subtype/variant of embryonal carcinoma
- Ependymoma **9391** and a subtype/variant of ependymoma
- Glioblastoma **9440** and a subtype/variant of glioblastoma
- Immature teratoma **9080** and a subtype/variant of immature teratoma
- Malignant meningioma **9530** and a subtype/variant of malignant meningioma
- Malignant peripheral nerve sheath tumor **9540** and a subtype/variant of malignant peripheral nerve sheath tumor
- Medulloblastoma **9470** and a subtype/variant of medulloblastoma
- Meningeal melanoma **8720** and a subtype/variant of meningeal melanoma
- Oligodendroglioma **9450** and a subtype/variant of oligodendroglioma
- Pilocytic astrocytoma **9421** and a subtype/variant of pilocytic astrocytoma
- Pineal parenchymal tumor of intermediate differentiation **9362** and a subtype/variant of pineal parenchymal tumor of intermediate differentiation
- Sarcoma **8800** and a subtype/variant of sarcoma

Note: See Table 3 in the Equivalent Terms and Definitions to find NOS and subtypes/variants.

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Malignant Tumor Rules

Rule H7 Code the **subtype/variant** when **all tumors** are a **NOS** and **a single subtype/variant** of that NOS such as the following:
Note: All tumors are malignant/invasive /3.

- Astrocytoma **9400** and a subtype/variant of astrocytoma
- CNS ganglioneuroblastoma **9490** and a subtype/variant of CNS ganglioneuroblastoma
- Embryonal carcinoma **9070** and a subtype/variant of embryonal carcinoma
- Ependymoma **9391** and a subtype/variant of ependymoma
- Glioblastoma **9440** and a subtype/variant of glioblastoma
- Immature teratoma **9080** and a subtype/variant of immature teratoma
- Malignant meningioma **9530** and a subtype/variant of malignant meningioma
- Malignant peripheral nerve sheath tumor **9540** and a subtype/variant of malignant peripheral nerve sheath tumor
- Medulloblastoma **9470** and a subtype/variant of medulloblastoma
- Meningeal melanoma **8720** and a subtype/variant of meningeal melanoma
- Oligodendroglioma **9450** and a subtype/variant of oligodendroglioma
- Pilocytic astrocytoma **9421** and a subtype/variant of pilocytic astrocytoma
- Pineal parenchymal tumor of intermediate differentiation **9362** and a subtype/variant of pineal parenchymal tumor of intermediate differentiation
- Sarcoma **8800** and a subtype/variant of sarcoma

Note: See Table 3 in the Equivalent Terms and Definitions to find NOS and subtypes/variants.

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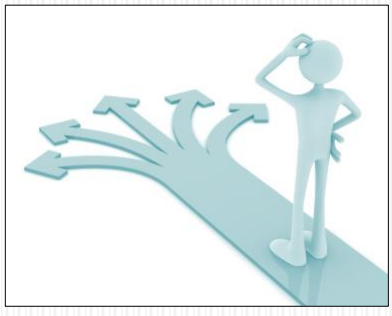
Staging Brain and CNS Neoplasms



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AJCC TNM, 8th edition

"Attempts to develop a TNM-based classification and staging system for central nervous system tumors have been neither practical nor pertinent. Early editions of this manual proposed a system that was used with poor compliance and was not useful as a predictor of outcome, neither in practice nor in clinical trials for patients with primary CNS Tumors."

"The CNS expert panel continues to recommend that a formal TNM-based classification not be attempted. We continue to incorporate the WHO CNS tumor nomenclature and classification, which were revised in 2016, and the ICD topography system for location of the lesions."

AJCC Stage = 88 (Not Applicable)

Includes: ANY Benign
or ANY Malignant Neoplasm

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AJCC TNM, 8th edition

Factors Felt to be of Prognostic and/or Clinical Significant Include:

- Tumor Histology
- Location of Tumor
- Unifocal or Multifocal
- WHO Grade of Tumor
- Patient Age at Diagnosis
- Functional Neurologic Status (Karnofsky Score, QOL)
- Primary or Recurrent Tumor
- Extent of Resection
- Molecular Aspects
  - IDH Mutation for gliomas
  - 1p, 19q deletions for gliomas
  - MGMT methylation stqtus for gliomas

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SEER Summary Stage 2018

To obtain a FREE electronic copy of the SS2018 Manual:
http://seer.cancer.gov/tools/ssm/

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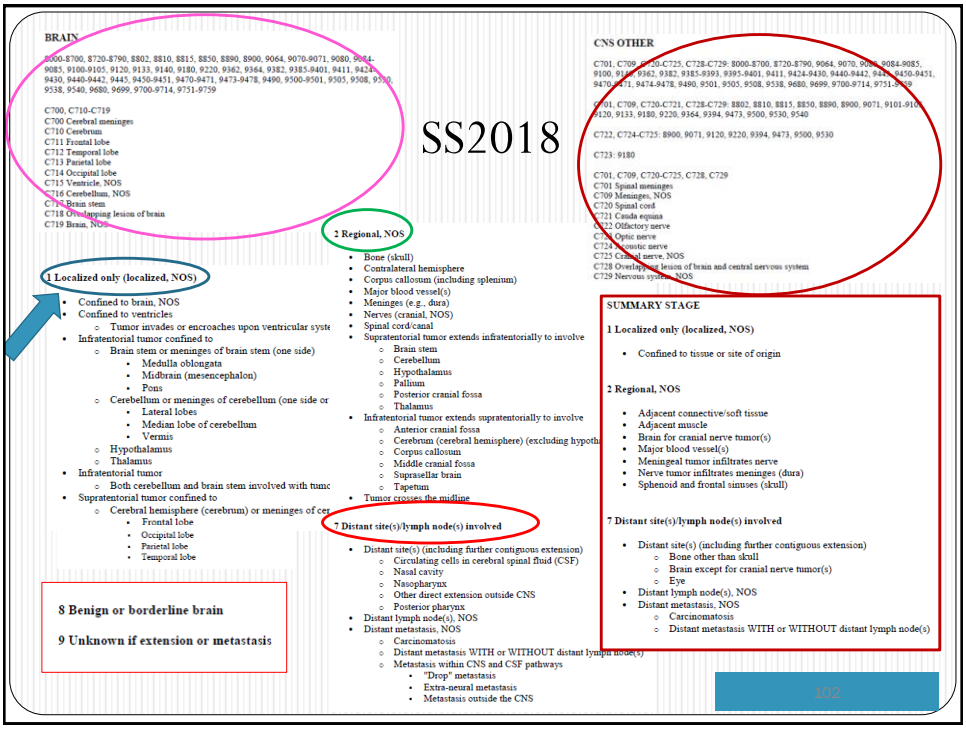

Steps to Assign SS2018

Three summary stage groups can be ruled out quickly: in situ, distant, and localized

FIRST

In situ

1. Rule out in situ stage disease. Carcinomas and melanomas are the only types of cancer that can be classified as in situ. Only carcinomas have a basement membrane. Sarcomas are never described as in situ. A pathologist must examine the primary organ and state that the tumor is in situ. If the cancer is anything except a carcinoma or melanoma, it cannot be in situ.
2. If there is any evidence of invasion (or extension to), nodal involvement or metastatic spread, the case is not in situ even if the pathology report so states. This is a common error in staging cervical cancer where the path report states that the cancer is "in situ with microinvasion"—such a case would be staged as localized.

In Situ Stage is Not Applicable for Brain/CNS Tumors

In Situ Stage is Not the Same as Benign or Borderline Behavior

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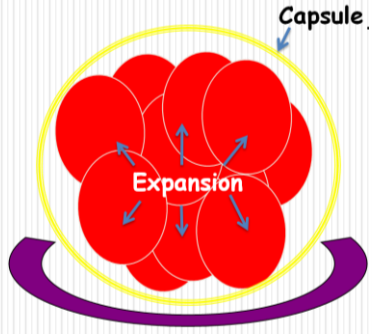
SS2018 for Benign/Borderline Tumors

= 8



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Steps to Assign SS2018

Three summary stage groups can be ruled out quickly:
in situ, distant, and localized
SECOND

Distant

3. Rule out distant disease. If metastases can be documented, there is no need to spend a great deal of time identifying local or regional spread. If distant metastases are recorded on x-ray or needle biopsy, the stage is already determined and the patient does not need to undergo a lot of other tests.
4. Hematopoietic diseases, such as leukemia and multiple myeloma, are considered disseminated or distant at time of diagnosis.
5. Rule out distant spread by reading the operative report for comments about seeding, implants, liver nodules, or other indications of metastases. Read diagnostic reports for references to distant disease.
6. If nodes, organs, or adjacent tissues are not specifically mentioned in the description of the various categories, attempt to cross-reference the term you have with those outlined. If there is no match, assume the site in question represents distant disease.

Brain and CNS these are usually CSF Involvement – cells in fluid
On rare occasion you may see "drop metastasis" – code as Distant Stage

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Steps to Assign SS2018

Three summary stage groups can be ruled out quickly:
in situ, distant, and localized
THIRD

Localized

7. Rule out that the cancer is "confined to the organ of origin." In order for a lesion to be classified as localized, it must not extend beyond the outer limits of the organ and there must be no evidence of metastases anywhere else.
8. Terms such as "blood vessel invasion" or "perineural lymphatic invasion" do not necessarily indicate that the cancer has spread beyond the primary organ. If tumor at the primary site has invaded lymph or blood vessels, there is the potential for malignant cells to be transported throughout the body. Step 1 (invasion), has occurred, but not necessarily steps 2 (transport of cancer cells) and 3 (growth at the secondary site). The case may still be localized.
9. Vascular invasion within the primary is not a determining factor in changing the stage unless there is definite evidence of tumor at distant sites.

Most common Summary Stage – unless tumor crosses midline

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Steps to Assign SS2018

Three summary stage groups can be ruled out quickly: in situ, distant, and localized
FINAL (if needed)

Regional

10. If in situ, local and distant categories have been ruled out, the stage is regional.
11. For carcinomas, if there are lymph nodes involved with the tumor, the stage is at least regional.
12. For tissues, structures, and lymph nodes, assume ipsilateral unless stated to be contralateral or bilateral.

Unknown if Extension or Metastasis

13. If there is not enough information in the record to categorize a case, it must be recorded as unstageable.

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Surgery & New Targeted Therapies

- Benign Tumors may be treated with surgery when large.
- Benign Tumors more often are treated by gamma knife or other stereotactic radiosurgery techniques
- Surgery is the treatment of choice for malignant tumors – particularly if good margins can be achieved. If any tumor remains, the patient is at high risk for progression which may be called recurrence.
- Radiation Therapy to treat remaining tumor using IMRT, 3D-CRT or Proton Beam – stereotactic radiosurgical techniques for benign
- Chemotherapy to treat microscopic remaining tumor
- Everolimus (Afinitor) for subependymal giant cell astrocytoma or SEGA that cannot be completely resected

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Additional Resources

- **The 2007 WHO Classification of Tumours of the Central Nervous System,** David N. Louis, Hiroko Ohgaki, Otmar D. Wiestler, Webster K. Cavenee, Peter C. Burger, Anne Jouvet, Bernd W. Scheithauer and Paul Kleihues, World Health Organization, Lyon, France, 2007
- **2016 Revision to the 2007 WHO Classificatio of Tumours of the Central Nervous System, Fourth Edition, 2016**
- **Central Brain Tumor Registry of the United States (CBTRUS)**, cbtrus.org, 2019
- **American Brain Tumor Association (ABTA),** abta.org, 2019
- **American Cancer Society Cancer Facts and Figures, 2019**
- **NCCN Evidence Based Treatment Guidelines**, nccn.org, 2019
- **Data collection of primary central nervous system tumors. National Program of Cancer Registries Training Materials.** Department of Health and Human Services, Centers for Disease Control and Prevention. Atlanta, Georgia, 2004.
- **Solid Tumor Rules and Manual**, SEER 2019
- **AJCC Cancer Staging Manual**, 8th ed., AJCC, 2017
- **SEER Summary Staging Manual 2018**

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QUESTIONS ??

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