ACRODeck

Meningiomas

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Introduction to ACRODeck

ACRODeck

- The goal of ACRODeck is to introduce standard treatments of oncologic malignancies for early radiation oncology residents

- Please note that there is often considerable variation in standard treatment recommendations

- Moreover, the landscape of oncology is ever-changing; for practice changing landmark studies and feedback, please email: resident@acro.org

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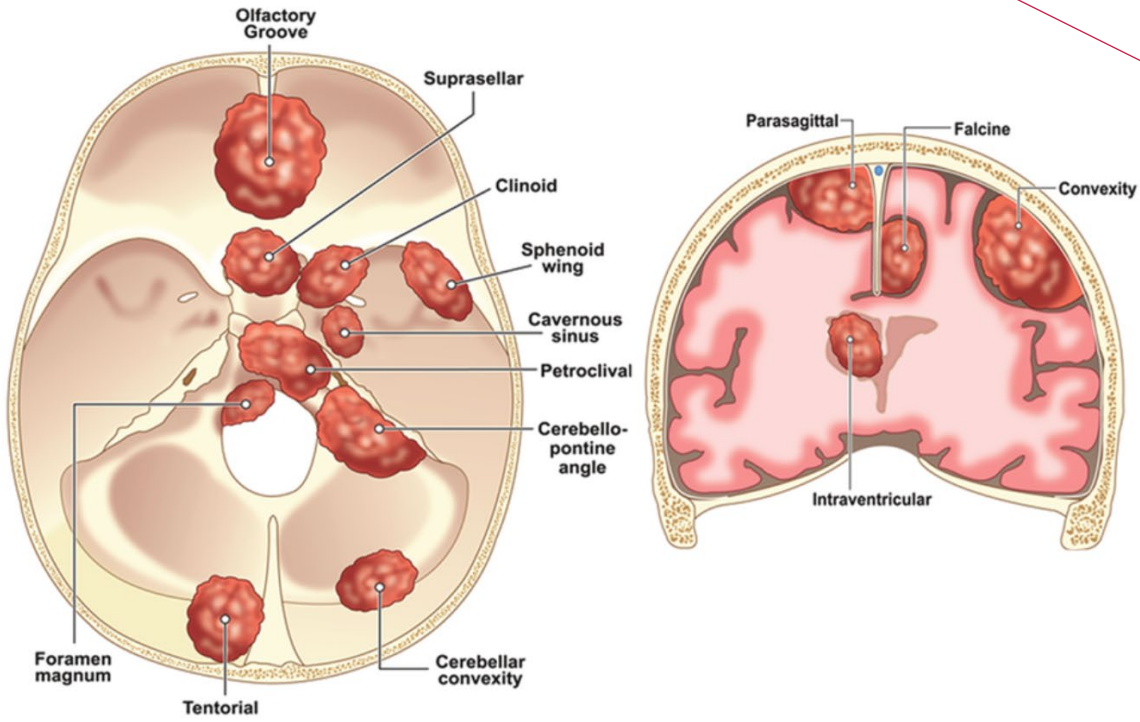
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Clinical Presentation and Differential Diagnosis

Meningiomas are the most common primary brain tumor, accounting for about 40% of cases

- As with any CNS lesion, the location of the lesion will determine the clinical presentation
  - Meningiomas are commonly found in supratentorial areas of dural reflection
  - While they can be found incidentally and be asymptomatic, symptoms may include neurologic deficits, headaches, altered mental status, motor and sensory deficits, nausea and vomiting

- Differential Diagnosis:
  - Glioma
  - Ependymoma
  - Lymphoma
  - Brain metastasis
  - Intracranial abscess
  - Empyema
  - Multiple sclerosis



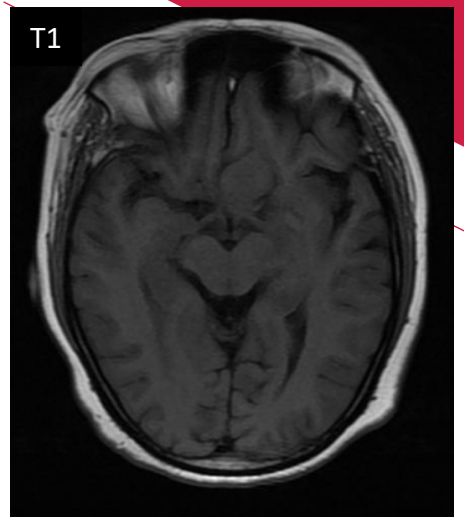
Initial Workup

Meningiomas are a radiologic diagnosis: if there is uncertainty, an octreotide scan can be considered

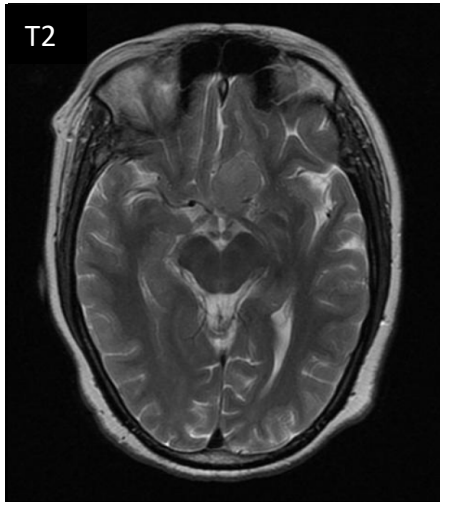
- H/P
- CBC and CMP
- CT Head with contrast
- MRI brain with and without contrast (obtain one within 48 hours after surgery as well)
  - Classic findings: **Well-circumscribed, homogenously contrast enhancing, dural based, extra-axial mass with a dural tail**

MRI Sequence	Appearance
T1	Usually isointense
T1c	Intense homogeneous enhancement
T2 / FLAIR	Usually isointense





Radiopaedia



- If symptomatic, consider steroids and anti-epileptics
- If symptomatic and/or concern for a higher grade, a maximal safe resection may be indicated

Staging

Around 90% of meningiomas are WHO Grade 1

- Primary CNS tumors are graded, not staged

WHO Grade	Example of Subtypes
1	Meningothelial and Fibrous
2	Atypical, Chordoid, Clear Cell
3	Anaplastic, Papillary, Rhabdoid

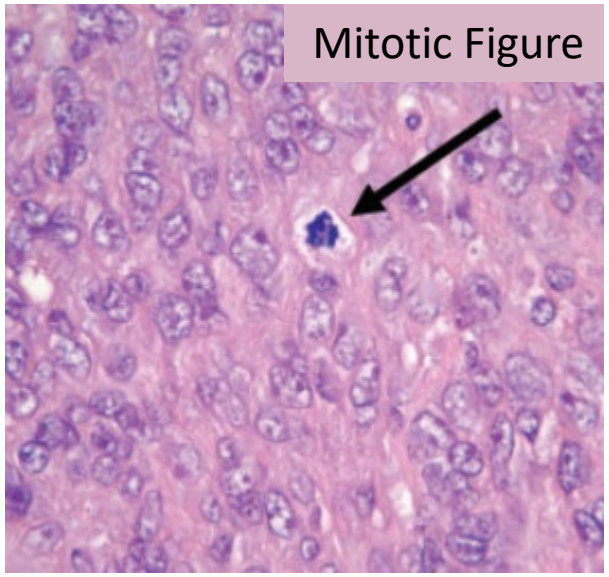
Pathology

The meningothelial subtype accounts for 60% of all meningiomas

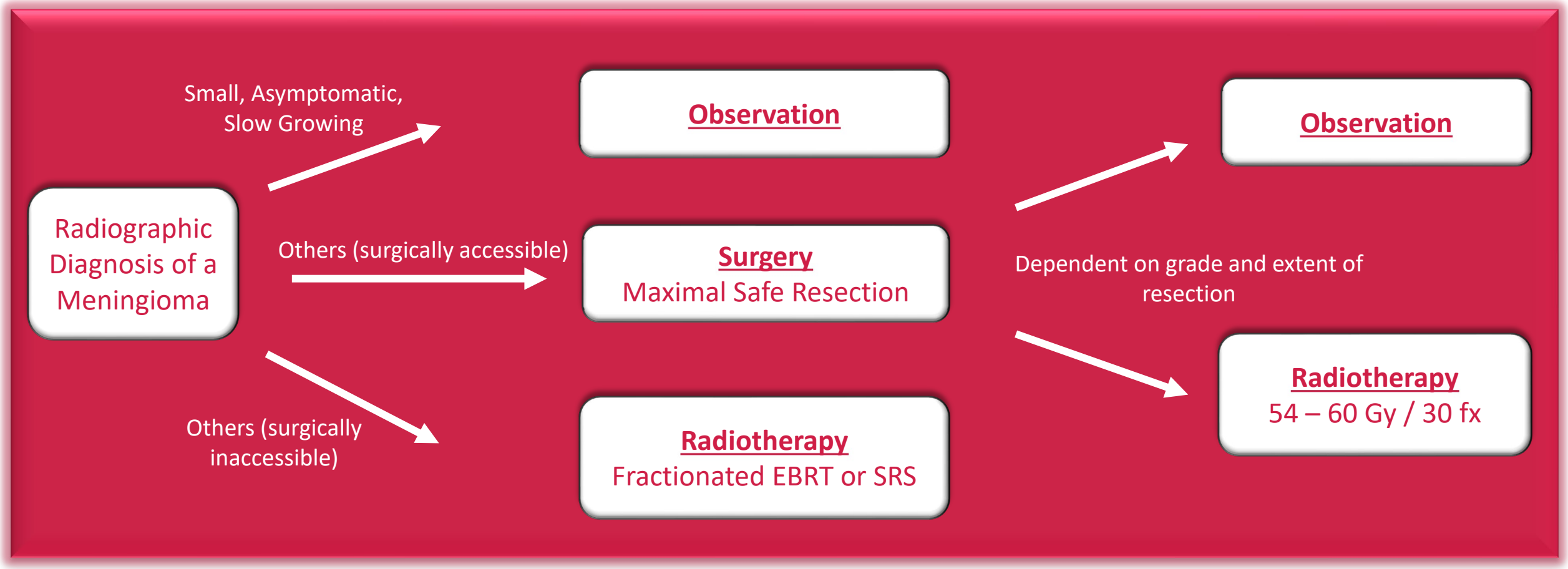
- Per CNS WHO 2021, a total of 15 subtypes of meningioma are recognized
  1. Meningothelial meningioma
  2. Fibrous meningioma
  3. Angiomatous meningioma
  4. Lymphoplasmacytic-rich meningioma
  5. Metaplastic meningioma
  6. Microcystic meningioma
  7. Psammomatous meningioma
  8. Secretory meningioma
  9. Transitional meningioma

  10. Atypical meningioma
  11. Chordoid meningioma
  12. Clear cell meningioma

  13. Anaplastic meningioma
  14. Papillary meningioma
  15. Rhabdoid meningioma



Treatment Summary: Meningiomas



Observation

Consider age, performance status, and comorbidities prior to treatment

- Observation can be done for WHO grade 1 meningiomas that are:
  - Asymptomatic
  - In a non-eloquent location
  - Less than 3 cm in size
- Growth rate is estimated at 1 – 2 mm / year

Surgery

There are locations (cavernous sinus, optic nerve sheath) where radiation is preferred to surgery

If definitive treatment is preferred, surgery is the mainstay

- A maximal safe resection is typically indicated

- The extent of resection has been graded via the Simpson System

TABLE 4.4: Simpson Grading System for Meningioma Resection

Grade	Extent of Resection	Recurrence Rate at 5 Years (%)
0	GTR, including dural attachment and bone plus stripping of 2–4-cm dura	0
1	GTR, including dural attachment and any abnormal bone	9
2	GTR, with coagulation instead of resection of dural attachment	19
3	GTR of meningioma without resection or coagulation of dural attachment	29
4	Subtotal resection	44
5	Tumor debulking or decompression only	N/A

Chemotherapy

Sunitinib is a small molecule that inhibits multiple receptor tyrosine kinases

There is no upfront role for systemic therapy in meningiomas

- Sunitinib, bevacizumab, bevacizumab + everolimus, and somatostatin analogues (octreotide) may by useful in certain progressive and treatment refractory situations

Radiation

Margins and doses vary widely amongst institutions; RTOG 0539 risk groups are an accepted standard

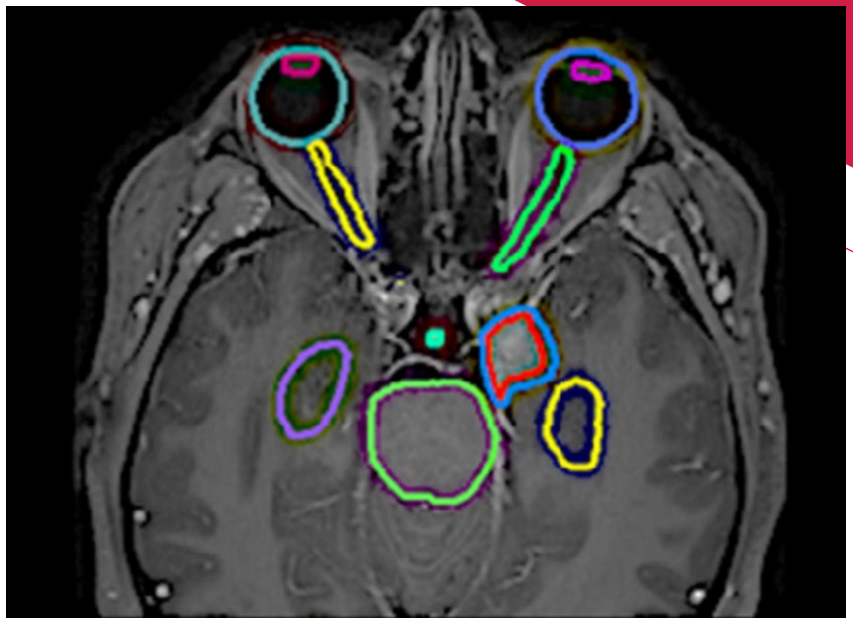
Simulation

- CT head without contrast
- Brain MRI with and without contrast
- Face mask

Volumes

- **GTV** = tumor + post-op bed
  - Seen best on the T1c MRI; no edema is included
- **CTV** = 0.5 – 3 cm expansion
  - NCCN states 0.5 – 2 cm for grade 2 meningiomas, and 2 – 3 cm for grade 3 meningiomas
  - Recent NRG trials have trended towards smaller expansions
- **PTV** = 0.3 – 0.5 cm expansion

- Inclusion of the dural tail and/or hyperostotic bone is of some debate
  - Recent protocols do not specify inclusion of the dural tail
  - Inclusion of hyperostosis is often done due to high rate of bone involvement



PMID: 33309848 (ESTRO ACROP)

- Cavernous sinus meningioma (red)
- Left optic nerve (lime green)
- Right optic nerve (yellow)
- Right hippocampus (purple)
- Left hippocampus (gold)

Fractionated Radiation Dosing Example

Modern radiation techniques (IMRT, VMAT, SRS, and protons) are often utilized to minimize toxicities

	Grade 1	Grade 2	Grade 3
GTR	Observation	54/30	60/30
STR	Observation	60/30	60/30
Recurrent	54/30	60/30	60/30

SRS Dosing Example

If OAR dose constraints cannot be met for a single fraction approach, occasionally a 5-fraction treatment can be utilized

	Grade 1	Grade 2	Grade 3
Single Fraction Dose	12 - 16 Gy	16 – 20 Gy	N/A
Five Fraction Dose	25 – 30 Gy	27.5 – 30 Gy	N/A

Selected CNS Dose Constraints

PMID: 33864823

Organ at Risk (OAR)	Fractionated Radiation Dose Constraint (Gy)	1 Fraction Radiation Dose Constraint (Gy)	5 Fraction Radiation Dose Constraint (Gy)
Optic Nerves and Chiasm	Max < 54 – 60	Max < 8 – 10	Max < 25
Brainstem	Max < 54 - 60	Max < 12 - 14	Max < 30

Radiation Toxicities

Radiation-induced meningiomas are the most commonly reported secondary neoplasm

- Acute:
  - Fatigue
  - Alopecia
  - Nausea
  - Skin erythema

- Chronic:
  - Swelling
  - Radionecrosis
  - **Location-Dependent:** for example, meningiomas of the cavernous sinus (located just medial to the hippocampus) may carry a higher risk of cognitive decline

Prognosis

The WHO Grade is the dominant prognostic factor

- Meningiomas have a prolonged natural history
  - Many can be observed; those that are treated either with surgery and/or radiation have excellent rates of local control
  - However, higher-grade tumors (i.e.: anaplastic meningiomas) can be quite devastating in terms of their local growth

Review

Review #1: Imaging

Gadolinium is a chemical element (symbol Gd and atomic number 64)

What is the most appropriate MR imaging study to visualize a meningioma?

(A) T1

(B) T1c

(C) T2

Review #2: Pathology

Grade 1 meningioma: < 4 mitoses/HPF
Grade 2 meningioma: 4-19 mitoses/HPF
Grade 3 meningioma: ≥ 20 mitoses/HPF

Which histological variant is classified as a grade 3 meningioma?

(A) Clear cell

(B) Choroid

(C) Rhabdoid

Review #3: Systemic Therapy

Systemic therapy is only offered when the tumor is not surgically accessible, and radiation is not an option

Which systemic agent has shown efficacy in a phase II trial and has a NCCN category 2B recommendation for meningiomas?

(A) Sunitinib

(B) Imatinib

(C) Temozolomide

(D) PCV

Review #4: SRS Dosing

Per NCCN

Which of the following is an appropriate marginal dose for single fraction SRS for a WHO Grade 1 meningioma?

(A) 8 Gy

(B) 14 Gy

(C) 18 Gy

(D) 24 Gy

Review #5: Fractionated Radiation Dosing

Recurrent grade 1 meningiomas were classified as intermediate risk per RTOG 0539

Which of the following is a reasonable dose range for a recurrent grade 1 meningioma?

(A) 12 – 16 Gy

(B) 30 – 36 Gy

(C) 50.4 – 54 Gy

(D) 60 – 66 Gy

Answer Key

1. B
2. C
3. A
4. B
5. C

NRG BN-003 is exploring omission of radiation following a GTR of a WHO Grade 2 meningioma