Ganglioglioma

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Contents

10.1 General Principles of Simulation and Target Delineation (Table 10.1)

- Information on simulation
  - Recommended imaging

    Preoperative as well as postoperative imaging should be obtained. Imaging sequences should include at least T1, T1 with contrast, T2, and FLAIR. Consideration to obtaining either susceptibility-weighted imaging, T2 gradient recalled echo, or T2 star as these sequences can be helpful in delineating the operative bed and distinguishing blood products from residual disease.

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Table 10.1 Target volume guidelines

Target volumes	Definition and description
GTV	The GTV should include the entire operative bed as well as any and all residual contrast-enhancing volume as this may represent gliosis or residual tumor
CTV	The CTV should extend at least 0.5 cm from the operative bed for low-grade gangliogliomas, while 1–2 cm may be more appropriate for high-grade (anaplastic) gangliogliomas. The CTV should be anatomically constrained by barriers for spread such as bone, tentorial or discontinuities in tissue across fissures, ventricles, etc.
PTV	The use of a PTV is recommended for prescription of all photon cases. Typically 0.3–0.5 cm is appropriate. Proton plans are typically prescribed to the CTV with subsequent robust optimization with various combinations of positioning/setup and range uncertainties. The impact of all robustness scenarios should be evaluated in terms of their subsequent impact on target coverage. Positioning uncertainties of 3–5 mm and 3–5% differences in range uncertainty are appropriate for most intracranial cases

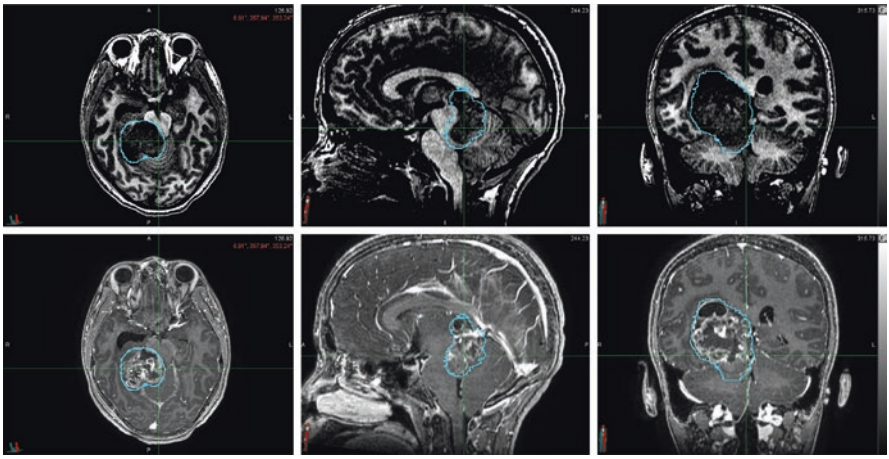


Fig. 10.1 Preoperative tumor volume. Top row: T1 stealth. Bottom row: T1 stealth + contrast. Blue = preoperative tumor volume segmentation

  - Patient positioning
    Supine positioning and immobilization with a short aquaplast mask is recommended. The use of photon vs. proton radiotherapy may dictate head position or the need for other special setup devices like table-associated range shifter, etc.
- Recommendations for target delineation (Figs. 10.1 and 10.2)
  - Imaging sequences and special circumstances
    The T1 and T1 contrast-enhanced studies are most useful for delineation of the operative bed and determining if residual disease is present. Most high-grade gangliogliomas will enhance with contrast on T1, while low-grade gangliogliomas may only partially enhance or not enhance at all. T2 imaging is

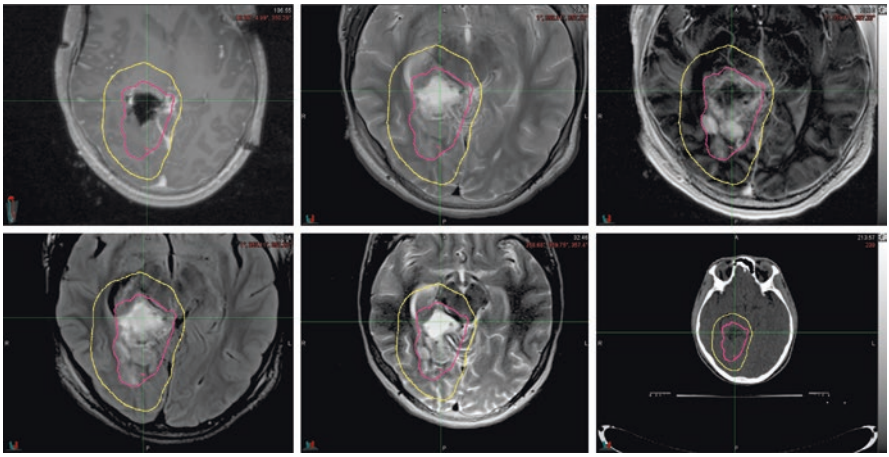


Fig. 10.2 Postoperative treatment volumes. Top row, from right to left: T1 post-contrast, T2, T1 subtraction. Bottom row, from right to left: T2 flair, T2 fast spin echo, CT planning scan. Pink, gross tumor volume; yellow, clinical target volume

useful for delineating the operative bed as it highlights the presence of cerebrospinal fluid within the cavity, while susceptibility-weighted imaging may illustrate regions that the surgeon explored intraoperatively which are not apparent after review of the operative report or the T1 contrast-enhanced study.

– On treatment imaging

Most gliomas can exhibit pseudo-progression which may occur during therapy. Interval imaging at 1–2 week intervals may be useful when smaller disease volumes are utilized to ensure that a marginal miss or insufficient coverage does not occur during the course of therapy from volumetric changes in the tumor.

10.2 Dose Prescriptions

- Recommended doses for ganglioglioma range from 54 to 59.4 Gy depending on tumor grade and presence of residual disease. Most would favor 59.4 Gy for anaplastic ganglioglioma, while 54 Gy would be considered standard for treatment of low-grade ganglioglioma cases after progression on chemotherapy following resection.

10.3 Treatment Planning Techniques (Table 10.2 and Fig. 10.3)

- Modality
  - Protons or 4–6 MV photons are typically utilized for treatment.
- Treatment technique

Table 10.2 Recommended coverage guidelines and dose constraints

Organs at risk	Suggested dose constraints
PTV	D100% = 95%
	V110% ≤ 10%
Cochleae	D50% ≤ 35 Gy—goal
	D50% ≤ 20 Gy—preferred
Optic globes	D50% ≤ 10 Gy—goal
	D10% ≤ 35 Gy—goal
	D50% ≤ 20 Gy—maximum
	D10% ≤ 54 Gy—maximum
Optic chiasm	D50% ≤ 54 Gy—goal
	D10% ≤ 56 Gy—goal
	D50% ≤ 56 Gy—maximum
	D10% ≤ 58 Gy—maximum
Optic nerves	D50% ≤ 54 Gy—goal
	D10% ≤ 56 Gy—goal
	D50% ≤ 56 Gy—maximum
	D10% ≤ 58 Gy—maximum
Spinal cord (superior 6 cm)	D50% ≤ 26 Gy—goal
	D10% ≤ 57 Gy—goal
	D50% ≤ 50 Gy—maximum
	D10% ≤ 59 Gy—maximum
Brain stem	D50% ≤ 61 Gy—goal
	D10% ≤ 63 Gy—goal
	D50% ≤ 62 Gy—maximum
	D10% ≤ 64 Gy—maximum

References for dose constraints per ACNS0423 [1]

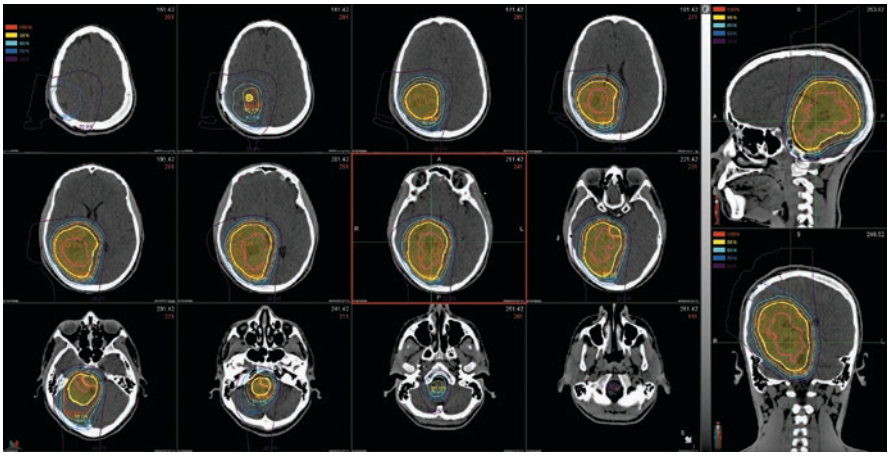
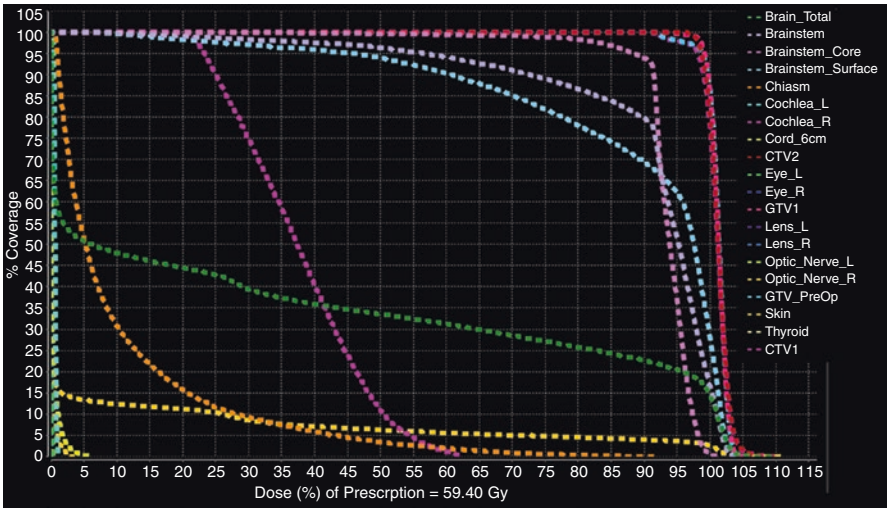


Fig. 10.3 Treatment plan. Isodose lines shown in red, yellow, turquoise, blue, and purple for 100%, 95%, 80%, 50%, and 20%, respectively. Pink, gross tumor volume; yellow, clinical target volume

  - Treatment technique with photons is highly location-dependent although IMRT is increasingly utilized. 3DCRT may be more favorable in situations where integral dose to the brain is of concern. VMAT may offer improved conformality and reduced treatment delivery times over IMRT; however, this may limit certain noncoplanar beam angles. Stereotactic radiosurgery (SRS) may be appropriate at the time of salvage for small focal recurrences or as a boost for residual disease, where further surgery was not possible. Proton therapy is increasingly favored for its dose fall off at depth and reduced integral dose. There are a wide variety of proton delivery methods (passive scatter, pencil beam scanning—single or multiple field optimization, etc.). Concerns over end of range biologic effects may be less pronounced with pencil beam scanning approaches.
- Representative DVH



10.4 Side Effects

- Acute side effects to evaluate during weekly on-treatment visits
  - Hair loss, fatigue, radiation dermatitis, headaches, nausea, seizures
- Late side effects and complications
  - The late effects of focal cranial radiotherapy are highly location-dependent but may include bony hypoplasia, increased soft tissue fibrosis, overlying subcutaneous hypoplasia, endocrine deficits, decline in hearing, neurocognitive and psychological sequelae, vasculopathy, second cancers, necrosis, and decline in vision or cataracts.
- Clinical pearls for addressing those side effects
  - If patients are on steroids at the time of radiotherapy, utilization of gastric prophylaxis (e.g., ranitidine) and evaluation for oral thrush are recommended.

- Topical water-based lotions are recommended for local application over the treated region following (but not before) treatment, three to four times per day depending on the topical lotion utilized.
- As gangliogliomas can be epileptogenic, patients generally are on seizure prophylaxis with levetiracetam during radiotherapy. Exacerbation of seizures during radiotherapy may require increase in anti-epileptic doses, additional anti-epileptic, and/or use of steroids.

Reference

1. https://clinicaltrials.gov/ct2/show/NCT00100802

Further Reading

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