The Role of Stereotactic Radiosurgery in Skull Base Lesions

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Objectives

By the end of this presentation, participants will be able to:

- Identify patients for whom SRS is appropriate
- Describe factors affecting successful outcome in SRS
- Select appropriate patients for SRS and counsel them regarding outcomes and risks of treatment
Disclosures

• I have nothing to disclose.
Types of Tumours

• Meningioma
• Schwannoma
• Chordoma
• Chondrosarcoma
• Glomus jugulare
• Olfactory neuroblastoma
• Metastases
Types of SRS

• LINAC
• Gamma Knife
• Proton beam
Upsides

• Short hospital stay
• Quick return to normal life
• Rates of progression-free survival compare very favourably

Downsides

• Size limit (20 cm$^3$)
• Surgery following SRS may be difficult
• Radiation toxicity
Factors Affecting Success

• Tumour size
• Tumour grade
• Optimal radiosurgical planning
  • Covering dural tail
  • Large size, irregular shape, proximity to visual pathways
Conformity Index = \( \frac{TV_{PIV}}{TV} \times \frac{TV_{PIV}}{PIV} = \frac{TV_{PIV}^2}{TV \times PIV} \)
From Kreil et al. http://dx.doi.org/10.1136/jnnp.2004.049213
Morbidity

• Cranial nerves
• Brainstem
• Hypothalamus
• Safe doses defined

Tumour volume
Margin dose
Previous radiation
Toxicity

• RTOG grading system (0-5)

  Edema, hemorrhage, radiation necrosis
  Neuropathy
  Encephalopathy
  Seizures
  Cognitive deficits
  Ataxia
Hypofractionation

- Maximize effect, minimize toxicity
- Extend volume and radiation dose constraints
- 3-5 fractions
Meningiomas

• Microsurgery considered treatment of choice
  • Total removal 60-90%
  • Post-op complications in 30-56%
• SRS may be adjuvant, or primary
• Ideal for tumours < 8 cm³
• Marginal doses of 12-16 Gy
• Local control rates excellent (90-100%)
• Cranial neuropathies 8-20%
Vestibular Schwannomas

• Treated since 1969
• Marginal dose 12-14 Gy
• Excellent rates of tumour control
• Functional preservation of facial and trigeminal nerves
• Hearing preservation ranges 30-80%
From Daniel et al., Optimally Invasive Skull Base Surgery for Large Benign Tumors, 2013.
Prognostic Factors for Hearing Loss

- Pre-treatment hearing grade (Gardner-Robertson, AAO-HNS)
- Radiation dose to cochlea
- Length of irradiated cochlear nerve
- Marginal dose to tumour
- Age
- Transient volume expansion after SRS
  - ABR values correlate with intracanalicular pressure
Jugular Paraganglioma

• Marginal tumour dose 15-16 Gy
• Cochlear dose 4-7 Gy
• Tumour control excellent
• Pulsatile tinnitus decreased
• Hearing preservation 80-90%
Chordoma/Chondrosarcoma

• Share propensity for anatomic location and high risk of local recurrence
• Maximal safe surgical resection followed by radiation
• Considered radioresistant
• High dose proton therapy
• Hypofractionated SRT provides similar rates of success/morbidity
• Median marginal dose 30 Gy
Craniopharyngioma

- SRS is optimal treatment for recurrence
- Larger/invading tumours: partial surgical resection + SRS
- Marginal dose 12-14 Gy
- Local control rates 85-90% at 3 years
- Neurological toxicity: visual deterioration, endocrine morbidity, seizures in up to 20%
Pituitary Tumours

• Surgical resection preferred treatment

• Tumours < 3cm, at least 2 mm from optic apparatus

• Nonsecreting 15-20 Gy
  • Secreting 20-25 Gy

• Endocrine remission 35-50%
  • Hypopituitarism 18%
Metastases

- Cranial nerve deficits, pain
- Median dose 18 Gy
Summary

• Why SRS?
  • Patient factors
  • Reduce morbidity
  • Outcomes comparable to or better than surgery