Clinical Target Volumes for Benign Brain Tumours

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Benign brain tumors: Road map

- Presentation, natural history and reasons to treat
  - Pituitary adenomas
  - Craniopharyngiomas
  - Acoustic neuromas
  - Meningiomas (WHO Grade 1)
- The gross and clinical targets for each
- The PTV and to what doses
Pituitary: Anatomic relations

- Optic chiasm
- Sphenoid sinus
- Cavernous sinus
Pituitary: Patterns of growth & symptoms/signs

Headache, vomiting
Cranial Nerves: Vision, 3rd, 4th, 5th & 6th
Amenorrhoea, galactorrhoea, acromegaly
Pituitary: Surgical approach & Reasons to treat

**Surgery**
- Non-functioning adenomas with mass effect
- Most secretory adenomas

**Medical therapy**
- Prolactinomas

**Residual** (cavernous sinus invasion or suprasellar)
**Recurrent** (sometimes aggressive histology)
**Persistently elevated hormonal levels** (i.e. failure of normalization of GH, PRL or ACTH)

Trans-cranial approach for parasellar extension, ICA encasement
Pituitary: What to draw

- This is a BENIGN tumor. Takes several years to attain the size which calls attention (in non-functioning ones)
  - So, no hurry to treat a residual. It can be done 3-6 months after surgery or at any time later

- Imaging needs:
  - The narrower, the better (2 mm for SCRT) say 3 mm for conventional
  - Plain and contrast scans (Distinction with clivus is blurred, so avoided)
  - Study axial, sagittal and coronal scans on MRI to identify patterns of spread
  - Extension to sphenoid sinus can be real or more usually post surgical fat pad
  - If in doubt about involvement of an area, contour it!
  - So draw OBVIOUS residual and PRESUMED residual into one outline: Call it whatever you want GTV or CTV. No margins beyond obvious tumour are needed for a CTV
  - 3-5 mm (or more) margin for PTV & 45 Gy/25 fx/5 weeks for all types
Craniopharyngioma

- Tumor arises from the remnant of Rathke’s pouch in the supra-sellar area
- Usually cystic in children
- Headaches, visual problems and consequences of hypothalmic-pituitary damage
- Treatments:
  - Surgery (Biopsy, cyst drainage, partial removal or complete removal [mortality, morbidity, hypothalmic damage, visual deterioration, endocrine complications In 30-70%])
  - Partial excision + FSRT= 10yr FFP-75 to 85%
Craniopharyngioma: What to draw?

- Tumor has proximity and propensity to invade with ‘finger like’ projections surrounding structures, i.e. pituitary & hypothalamus
- Use narrow slices, 2-3 mm and combination of plain and contrast CECT and T1-w (plain and with Gd) MRI in multiple planes
- See both pre-op and post op imaging
- GTV = visible residual lesion including solid and cystic components
- CTV = GTV (known microscopic extension is not considered a predictor of recurrence
- GTV (CTV) to PTV expansion 5 – 10 mm depending upon technology
- Dose = 50Gy in 30-33 fx (1.51-1.67 Gy/fx as proportion are children)

Minniti et al, Radiother Oncol 82:90-95, 2007
Acoustic Neuroma

- Benign tumor. Arises from VIII CN
- Slow growing (~1-4 mm/yr)
- Unilateral hearing loss, facial paresis, facial paresthesia, hydrocephalus
- Observation - till symptoms start bothering
- Radical surgery treatment of choice – damage to hearing and facial nerve
- Radiosurgery popular: radiation oncologists hardly get to treat this
- GTV = visible growth. No CTV. PTV according to immobilisation and technology (2-5mm)
- 21Gy/3fx, 40-48Gy, 50Gy/30fx, 54Gy/30fx
Meningioma (WHO grade 1)

- Meningiomas, 90% are benign, can occur at any meningeal surface

- Complete surgical excision is curative: depends upon size, location (e.g. encompassing cranial arteries, venous sinuses) and general condition

- Incomplete surgery: recurrence is 30-70% @ 5 - 10 yrs, with further RT- 80-85% (No RCT, benefit unproven)
Meningioma (imaging needs and what to draw)

- Study pre and post operative imaging (plain and CECT, T1-w –plain and with Gd), in multiple planes to appreciate spread of tumor
- RTP scans at 2-3 mm, fused with T1-w post Gd scans
- GTV = enhancing mass AND abnormal bone presumed to contain active tumour (If this condition is met, then no need to draw a separate CTV)
- PTV = 3-5 or 10 mm margin according to immobilisation and technology
- Outline brainstem, eyes, optic nerves and optic chiasm
- Doses: 50 – 55 Gy at 1.8Gy/tx (55Gy/33tx)

Alheit et al, Radiother Oncol 50:145-50, 1999
Meningioma (imaging needs and what to draw)

- MR shows more soft tissue
- CT shows bone destruction better
- MR shows volumes larger but not inclusive of CT volumes: so contour on both and use the union (till we know better)

Khoo et al, IJROBP 46:1309-17, 2000
Conclusion

- Imaging should include both CT and MR and studied carefully in all planes.
- RTP scans are 2-3 mm with contrast (except pituitary) and fuse with contrast enhanced MRI when available.
- For pituitary, acoustic, meningioma (WHO Grade 1) and craniopharyngeoma: GTV is what you see post operatively and include presumed tumor, such as shaved off bones, or cyst cavities.
- The need to expand to CTV is then not necessary.
- PTV expansion is based on immobilisation and radiation equipment in the main.