Feasibility of carbon ion radiotherapy as a new technique in the treatment of retroperitoneal neuroblastoma

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AIM
To evaluate CIRT as a potential new technique in the treatment of RNB

Retroperitoneal neuroblastoma (RNB)
- Radiosensitive kidneys close to RNB
- Challenging to meet tolerance dose

Carbon ion radiotherapy (CIRT)
- Sharp dose fall-off region
- Reduction of dose to OARs
- Sensitive to changing anatomy

METHODS

Patient data
- N=13 (mean 3.7 yrs) with extended midline or bilaterally RNB
- Originally treated at UMC Utrecht3 with photon beams (21.6Gy/12fx)
- Average-4DCT and daily CBCTs

Planning methodology
- CIRT plans created on 4DCT at GHMC2
- 2 beams only: combined lateral and posterior-anterior beams
- Equal dose contribution
- At least 95% of the planning target volume (PTV: internal clinical target volume (ITV)+3mm) should receive 95% of the prescribed dose
- D50% <20Gy for ipsilateral kidney (IK)

Dose accumulation
- 4DCT deformable registered to CBCTs
- Gastrointestinal gas delineated on CBCTs copied onto deformed CTs (density override =0.01)
- Dose distributions per fraction calculated on deformed CT and accumulated on 4DCT using a rigid bone match

RESULTS

Planned and accumulated dose distributions were compared using dose-volume parameters of the ITV and IK (p≤0.05)

- V95% of the ITV planned dose distribution (100-99.9%) differed from accumulated dose distribution (100-93.4%), p=0.01. Fig 1A and B represent patients with adequate target coverage and IK tolerance dose.
- Small deviations (≤3%) between planned and accumulated IK dose distributions varied between patients in magnitude and direction (p=0.06).
- For one child, V95% was <95% in the ITV for the accumulated dose (Fig 1C).
- For another child, planned D50% of IK did not satisfy the tolerance dose (Fig 1D).

CONCLUSIONS

- Varying gastrointestinal gas volumes caused dosimetric differences between planned and accumulated dose distributions.
- Adequate target coverage and kidney tolerance dose was obtained in all but two patients.