Radiotherapy for Pediatric Tumors

Dr Jyotirup Goswami
Consultant Radiation Oncologist
Narayana Cancer Institute
Narayana Superspecialty Hospital, Howrah

Indications

Acute Leukemias:

- Prophylactic cranial irradiation

Lymphomas:

- Involved field RT

Solid tumors:

- Post-operative (WT, NB, some EWS & RMS, medulloblastoma)
- Radical (EWS, RMS, RB)

Current status of RT

Systemic therapy strategies have improved exponentially

Across the board, RT doses & volumes have been progressively coned down

Late RT-toxicities have come to be recognised

Pros

- Proven disease control
- Due to low-to-moderate doses involved, generally do not require very high-tech equipment
- In fact, IMRT, which can lead to low-dose irradiation of non-target tissues, is yet to become a standard of care for pediatric tumors

Cons

- Timing of RT is crucial for some diseases like WT, which means comprehensive surgical & intensive care facilities need to be available, as well as a seamless throughput for referrals

- Small children often require short GA for CT-simulation & treatment, which may be difficult to organise in the treatment room, on a regular basis & with optimum monitoring

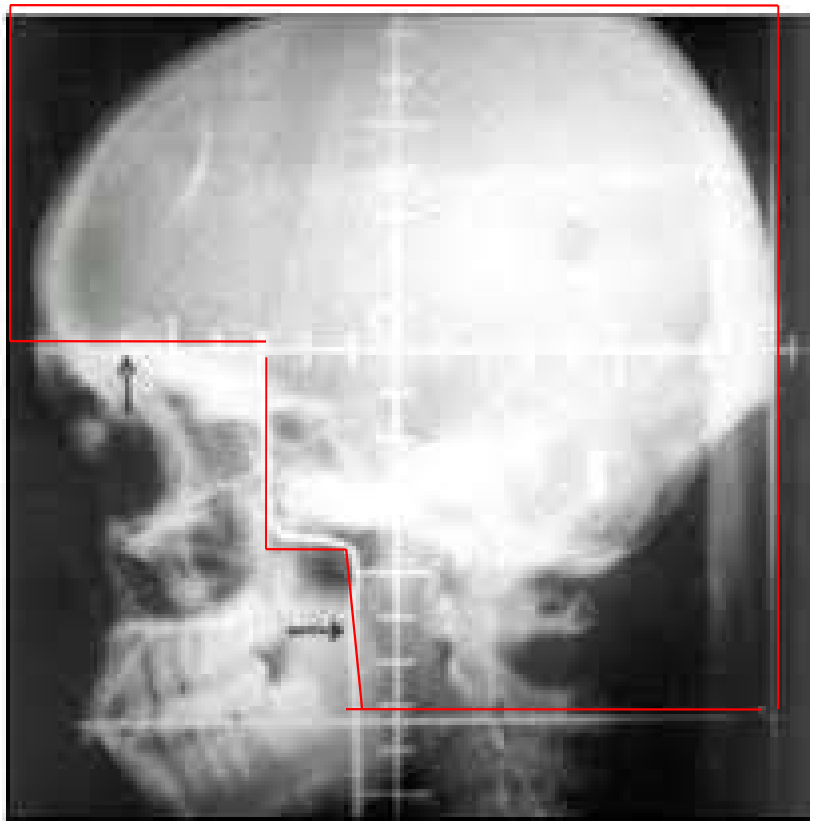
Special challenges

- Infertility & sterility: eg after CSI (medulloblastoma) can result due to extreme sensitivity of germ cells to even very low doses of radiation
- Growth retardation/ deformity: can result due to radiation of growth plates
- Cognitive dysfunction/ learning disability: can result from high-dose cranial radiation
- Secondary malignancies: can result from low-to-moderate dose radiation in childhood & adolescent years, especially breast & thyroid cancers.

RT for pediatric tumors: Current & emerging practice

Acute Lymphoblastic Leukemia

- PCI is given to patients in remission after induction therapy
- Current practice is to deliver as low a dose as 12.6Gy/7#/1.5 wks to the whole brain (down to C2)



Hodgkin's Lymphoma

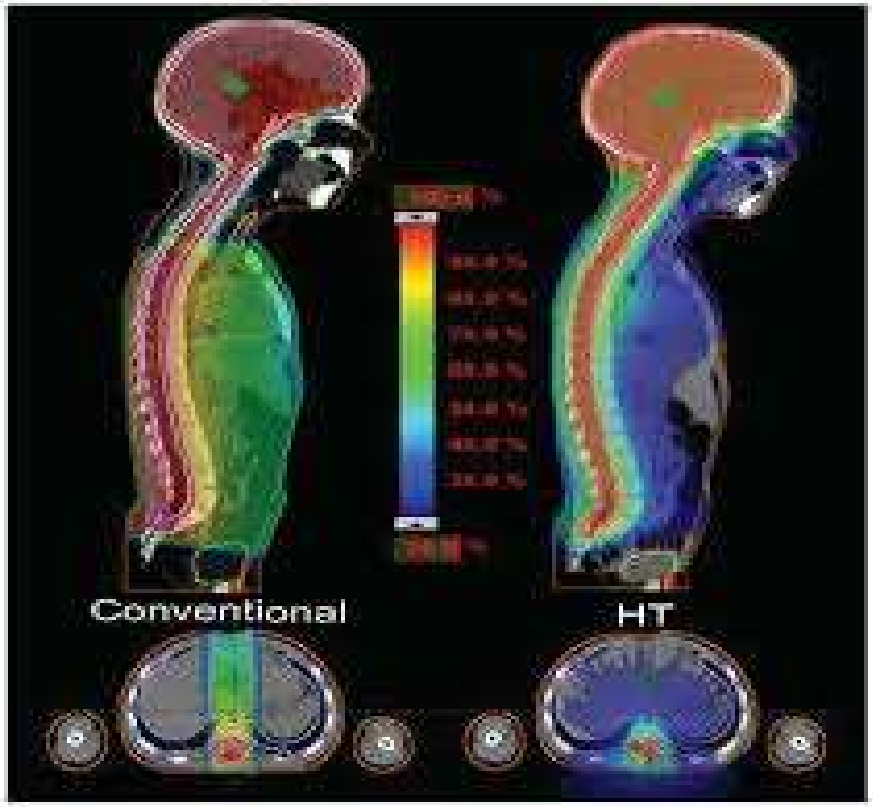
- Most modern protocols are looking to replace RT with more intensive chemotherapy
- Involved field & involved site RT has, in any case, led to reduction of treatment volumes from earlier extended fields
- Successful protocols have been able to reduce IFRT dose for children who achieve CR after chemotherapy, to as low as 14.4Gy/8#/1.5 wks

- A special case is a child with bulky early stage HL in unilateral neck:
- Here the IFRT should either avoid the growth plate OR to be given to bilateral neck
- Otherwise, unilateral growth retardation would lead to deformity

Medulloblastoma: Developments

- Adding concurrent chemotherapy has allowed us to reduce CSI dose in standard-risk cases to 23.4 Gy from earlier 35 Gy.
- Conformal boost to the tumor bed, as opposed to entire posterior fossa, reduces possibility of long-term cerebellar mutism

- Conformal techniques like tomotherapy allow good sparing of bone marrow, thyroid gland, kidneys & gonads during CSI.



Retinoblastoma: changing paradigm

- Earlier,EBRT used to be routinely used for post-enucleation patients with positive optic nerve margin & for unresectable cases to preserve vision
- EBRT was often correlated with development of secondary osteogenic sarcomas, owing to the patient's genetic predisposition
- This, along with the success of chemotherapy, has resulted in a strategy of chemoreduction followed by local therapy (cryotherapy/LASER/scleral plaque) in advanced RB.

Rhabdomyosarcoma

- RT should be instituted at week 9, following induction chemotherapy
- For parameningeal sites, RT needs to be given from week 0

Doses:

- *Microscopic disease* (IRS group I & II) - Gross pre-chemotherapy volume + margin: 41.4Gy / 23# / 4.5wks
- *Gross disease* (IRS group III)

  Phase I - Gross pre-chemotherapy volume + margin: 41.4Gy / 23# / 4.5wks

  Phase II - Post-chemotherapy volume + margin: 10.8-14.4 Gy/6-8#/1.5 wks
-

Ewing’s sarcoma

- Local therapy (S/RT) usually instituted after 9 weeks of induction chemotherapy
- Most sites today are addressed by surgery. Some of these cases may need PORT.
- Only unresectable disease,eg in axial skeleton, will need radical RT.

Post operative

- Phase I: Pre-chemotherapy volume + 2cm margin: 45Gy / 25# / 5wks

- Phase II: Post - surgery site of residual disease + 2cm margin:

  5. 4Gy / 3# / 0.5wk [If R1 resection with microscopically +ve margins]

  OR

  10.8Gy / 6# / 1 wk [If R2 resection with macroscopically +ve margins]

Unresectable

- Phase I: Pre-chemotherapy volume + 3cm margin: 45Gy / 25# / 5wks

- Phase II: Post-chemotherapy volume + 2cm margin:

1) If complete response after induction: no further boost

2) If $\geq$ 50% regression after induction: 10.8Gy / 6# / 1wk

3) If $\leq$ 50% regression after induction: 14.4Gy / 8# / 1.5wks.

Wilms' Tumor (NWTS-5)

Stage I & II FH Stage I anaplastic Rhabdoid tumor (≤ 1 year)	No radiation therapy
Stage III FH Stage IV FH with surgical stage III FH Stage II – IV anaplastic Stage I – IV CCSK	10Gy to abdomen + 10Gy boost to gross (>3cm) residual disease after surgery
Stage I – IV Rhabdoid tumor (> 1 year)	30Gy to flank
Stage IV (lung mets)	12Gy to lungs

Radiotherapy to be started within 10 days of surgery.

Where do we stand?

Problems facing RO in WB

- Late/ incidental diagnosis: preclude timely referrals & institution of neoadjuvant chemotherapy (which is required for most solid tumors)
- Lack of comprehensive care centres: with facilities for both pediatric oncology & radiotherapy
- Lack of national guidelines
- Lack of cross-talk between specialties involved in the care of pediatric solid tumors

Goals of a successful Pediatric Oncology Programme

- Timely diagnosis & referral
- Optimal investigation (tissue diagnosis & imaging)
- Proper sequencing of chemotherapy, radiotherapy & surgery
- Financial & logistic support to complete prolonged course of treatment
- Education & schooling support
- Vocational training
- Fertility preservation

Thank you