Planning aspect of Precision Radiotherapy

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Conventional Radiotherapy planning

- Based primarily on 2D planar radiographs
- Usually done with the aid of a Simulator
- Planned Treatment Portals by collimating rectangular fields that circumscribed the presumed tumor location on the basis of bony landmarks
- 2 to 3 beams are arranged in a standard geometry
- use Standard or Customize blocks for irregular fields & shielding of critical organs
Shortcoming of conventional planning

- Lack of 3D appreciations of tumor volume and its location w.r.t. sensitive organs
- 2D beam planning of a 3D tumor
- Dose computation perform on a single transverse plane
- Dose computation does not take in to account of scatter contribution from adjacent body tissue
Three Dimensional Conformal Radiotherapy (3DCRT)

Tightly Conformed image defined 3D shape of Tumor by therapeutic dose volume and conformally avoid surrounding normal tissue.
- In this Fig: Ideally White envelop (prescription dose) should paint on to the Red Volume (Tumor).
- Gap between dose & tumor volume mean extra normal tissue irradiated with prescription dose
- Red seen outside white mean fraction of tumor not receiving the prescription dose
Steps of 3DCRT

1. Imaging
2. Beam Shaping Block, MLC
3. Delineation of Target & critical organs
4. Immobilization
5. Plan Evaluation Physical dose
6. Dose computation
7. Plan Evaluation Biological dose
8. Total Uncertainty (Error)
Beam’s eye view (BEV) planning - 1978

provides the user with accurate reproduction of anatomic features from the viewpoint of treatment source.
Beam Planning

Done using Beam’s Eye View (BEV) in TPS

Thumbs rule:

a) beam geometry should separate PTV and OAR

b) Less beam entry length

c) wide hinge angle

d) beam geometry should preferably take the shape of PTV
Penumbra

6MV X-ray from LA

C0-60 from Telegama
Case: GBM

Plan 1: Ant + Lat Vs Post + Lat

Ant + Lt Lat
Ant TSD = 90.4 cm

Post + Lt Lat
Ant TSD = 92.7
Case: GBM

Plan1: Ant+Lat Vs Post+Lat

Ant + Lt Lat

Post + Lt Lat
Case: GBM

Plan 2: 2F_Post+Lat Vs 3F_ant+post+ltlat

Post + Lt Lat

Ant + Post + Lt Lat
Case: GBM

Plan 3: 3F_ 45° Wedge Vs 30° Wedge

Wedge angle = 90 - Hinge angle / 2
Case: GBM

Plan3: 3F_30° Wedge

Dose not conformed to PTV
Case: GBM

Plan 4: 3F_ Conformal beam

Conformal block

MLC
Case: Medulloblastome (Post fossa)

Parallel oppose Vs 3F_NCP

Co-planer
T=0, G=90
T=0, G=270

Non Co-planer
T=90, G=150-160
T=350, G=100
T=10, G=260
Case: Post fossa

Parallel oppose Vs 3F_NCP
Lt. eye

Rt. Eye
Supine treatment for CSI

T=0, G=270, C=9

T=0, G=90, C=351

T=0, G=180, C=0
Static conformal beam using mMLC
Static conformal beam

TMH Gold Standard
T=60, G=60
T=60, G=120
T=300, G=300
T=300, G=240
T=10, G=260
T=350, G=100
Static conformal beam
Cone vs. mMLC based SRS/SRT

- Clear physical and geometrical advantage over fixed fields for small spherical targets
  - For large irregular target
    - Multiple isocenters are necessary
    - Large dose inhomogeneity

- All the disadvantages in cone based system are overcome with micro MLC
  - Single isocenter with uniform dose distribution