Specification of Tumor Dose

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Prescription dose

- What do we mean by a dose prescription of 63 Gy?
  - Isocenter dose
  - Dose to 95% of isocenter dose
  - Minimum dose to target volume
  - Minimum dose to 95% of target volume
  - Mean dose to target volume
- Need to have consistent manner of specifying dose

Purpose

- To enable the resident to provide a precise and consistent description of the dose delivered to the patient
Definitions of dose/volumes

• High emphasis on precise dose calibrations, intercomparisons, etc
• Little emphasis on precise definition of dose and volumes
  – Required especially when comparing treatments among various practices, e.g. in interinstitutional protocols

ICRU documents

• ICRU Report 50: “Prescribing, recording and reporting photon beam therapy”
• ICRU Report 62: “Prescribing, recording and reporting photon beam therapy (supplement to ICRU Report 50)”

ICRU documents

• ICRU documents describe a methodology for treatment reporting and not treatment prescription
**Gross Tumor Volume (GTV)**

- “Gross demonstrable extent and location of the malignant growth”
  - Primary tumor
  - Involved nodes
  - Metastatic disease

- Adequate dose must be delivered to whole GTV to achieve aim of therapy
  - May not be possible to define GTV after surgical intervention

- Determining GTV
  - Clinical examination
  - Various imaging techniques

**Clinical Target Volume (CTV)**

- “Tissue volume that contains a demonstrable GTV and/or subclinical malignant disease that must be eliminated”
Clinical Target Volume (CTV)

- CTV delineated based on GTV with expansion for microscopic disease
  - Expansion based on clinical knowledge of spread of disease
- May be multiple CTVs, each with its own prescription – CTV I, CTV II, CTV III, etc

Clinical Target Volume (CTV)

- Delineation of GTV and CTV based on general oncological principles, independent of any therapeutic approach
- Definition of GTV and CTV must precede selection of treatment modality and treatment planning procedures
- It is not appropriate to modify GTV and CTV based on result of dose calculation

Internal Target Volume (ITV)

- CTV + internal margin (IM) to compensate for all movements
  - Respiration
  - Bladder and rectum fillings
  - Swallowing
  - Cardiac motion
  - Bowel motion
**Internal Target Volume (ITV)**

- Expansion of CTV based on knowledge of internal motion
- Population-based expansions
- Explicit expansions based on motion studies

**Planning Target Volume (PTV)**

- “A geometrical concept used for treatment planning, defined to select appropriate beam sizes and beam arrangements to ensure that the prescribed dose is actually delivered to the CTV”

**Planning Target Volume (PTV)**

- PTV is ITV + setup margin (SM) to account for setup uncertainties
  - Expansion of ITV based on knowledge of setup uncertainties
    - Immobilization devices
    - On-line imaging
  - It is not appropriate to modify setup margin based on result of dose calculations
  - PTV does not include margin for penumbra
    - Penumbra margin added when treatment portal is defined
Organs at Risk (OAR)

- “Normal tissues whose radiation sensitivity may significantly influence treatment planning and/or prescribed dose”
  – Planning Organ at Risk Volume (PRV): OAR + IM + SM

Additional volumes

- Volumes used to guide inverse planning should be identified as such and are independent of ICRU target volumes and organs at risk

Dose reporting

- Doses should be reported in terms of doses to an ICRU reference point
ICRU reference point

- The dose at the point should be clinically relevant
- The point should be easy to define in a clear and unambiguous way
- The point should be selected so that the dose can be accurately determined
- The point should be in a region where there is no steep dose gradient

In general, the ICRU reference point should be located in the central part of the PTV and, when possible, at the intersection of the beam axes.

Volumes to report

- GTV, CTV, ITV (not widely accepted, yet), PTV
- Treated Volume – that volume enclosed within specified dose envelope appropriate to achieve purpose of treatment
Volumes to report

- Irradiated Volume – that volume enclosed within specified dose envelope that is considered significant in relation to normal tissue tolerance

Doses to report

- Dose at ICRU Reference Point (ICRU Reference Dose)
- Maximum dose to PTV
- Minimum dose to PTV
- Maximum doses and volumes to organs at risk (when part of OAR is irradiated above tolerance level)

MDACC practice

- Prescription dose should cover entire CTV
- Prescription dose should cover 95% of PTV
- Specify key dose-volume parameters
  - Maximum dose to cord
  - Lung volume receiving at least 20Gy
  - etc