ARC TREATMENT PLANNING FOR LUNG TUMOR PHYSICIST PERSPECTIVE
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INTRODUCTION

- LUNG CANCER IS ONE OF THE MOST COMMON CANCER
- TREATMENT – SURGERY, RADIOTHERAPY & CHEMOTHERAPY
- RADIOTHERAPY FOR LUNG TUMOR:
  - As primary treatment
  - After surgery to eliminate any cancer cells that remain in the treated area
  - To treat lung cancer that has spread to the brain or other areas of the body
- Challenges in Radiotherapy – Heterogenity

When photon beams traverse heterogeneous tissues, several effects occur nearby the interface between low-density media (lung, sino-nasal, pharyngeal, tracheal or bronchial air cavities) and tissues of higher density (including tumours).

These effects are due to a loss of electron equilibrium: arriving electrons are not completely balanced in number by the produced (leaving) electrons.
TREATMENT TECHNIQUES

1. CONVENTIONAL RADIOTHERAPY
2. 3D CONFORMAL RADIOTHERAPY
3. IMRT
4. ROTATIONAL IMRT – HELICAL TOMOTHERAPY
5. VMAT
6. RESPIRATORY GATED RADIOTHERAPY
WORKFLOW

1. CT SIMULATION
2. CONTOURING
3. TREATMENT PLANNING
4. PRE TREATMENT VERIFICATION – IMRT, VMAT AND TOMOTHERAPY
5. IMAGE VERIFICATION
6. TREATMENT EXECUTION
CT SIMULATION

1. PATIENT POSITIONING
2. CHOOSING CORRECT IMMOBILIZATION
3. VERIFY PATIENT POSITIONING USING TOPOGRAM
4. CHOOSING SCANNING VOLUMES
5. SLICE THICKNESS AND SCANNING MODE (Helical or Axial)
6. 4DCT – FOR RPM
Why do we need IMRT?

- If the tumour is large or very close to the spinal cord
- If the tumour is wrapping around spinal cord
- For N3 disease where there are 2 distinct areas of disease
- For irregular shaped contours
- Then $V_{20}$ constraint can be impossible to meet
- Estimated spinal cord dose may be too high
- Or both of these problems
What are our options then

- IMRT – multiple fields and segments
- VMAT – more conformed and faster to deliver
- Tomotherapy

- Big Problems are:
  - Low dose bath, ie high V-5.
  - Interplay between moving MLCs and moving target

- If the expected benefits are greater than the uncertainties then IMRT/VMAT should be used.
VMAT

- Volumetric Arc Therapy – delivers radiation through gantry rotation
- Dose Dynamic Arc where the MLC shape and dose per degree change dynamically while the beam is on
- Variable dose per degree is achieved with variable dose rate and variable gantry speed
- Treatment is based on volumetric dose optimization
VMAT PLANNING

- Dose Prescription - 60 Gy/30#, 55 Gy/20#, 54 Gy/36# (CHART)
- No of Arcs and Arc angles
- Skip Arc
- Partial Arc
- Optimization
- Dose Constraints – PTV and OAR
  - PTV – ICRU 62 & 83 recommendation
  - OAR – Lung ($V_{20}$, $V_{10}$ and $V_{5}$), Spinal Cord, Liver, Esophagus and Heart
VMAT PLANNING AND DVH EVALUATION
ADVANTAGES

- BETTER FLEXIBILITY PLANNING
- Superior to 3DCRT with regards to dose conformity and sparing OAR
- Faster delivery time and reduces patient intra fraction motion
- LESSER MU THAN IMRT
DISADVANTAGES

- Lesser clinical trials
- Clinical trials are essential to confirm the safety and efficacy of VMAT techniques
- Lower dose delivered to large volume of lung
- Requires QA tests for plan verification
TOMOTHERAPY
Tomotherapy Overview

- Combination of IMRT with a helical CT
- A Megavoltage linear accelerator mounted on a ring gantry delivers photon fan beam as the patient progress through the ring
- Tomotherapy uses slice therapy delivering IMRT using fan beam and binary MLC’s
- Ability to produce Megavoltage CT image
- Daily MVCT images reduces patient
TOMOTHERAPY FOR LUNG CANCER

- Dose Prescription - 60 Gy/30#, 55 Gy/20#, 54 Gy/36# (CHART)
- FIELD WIDTH
- MODULATION FACTOR
- PITCH VALUE
- DIRECTIONAL BLOCK
- COMPLEYE BLOCK
PLANNING AND DVH EVALUATION
Pre-delivery checks

- Complex plans may hit the target precisely and miss the target precisely
- Need quality checks to avoid treatment delivery problems
- Need to ensure that dose intended is the dose delivered to the areas intended
- Patient-specific QA is necessary
**PRE TREATMENT VERIFICATION**

**Fluence**
- Analyse gamma evaluation and DTA (3% & 3mm)
- Film with cheese or Octavius Phantom or 2D Array with Octavius Phantom

**Point Dose**
- Verify TPS calculated Dose
- Cheese Phantom or Octavius Phantom using small volume ion chamber
- % Deviation - ± 3%
VMAT QA CHECK

TOMOTHERAPY QA CHECK
THANK YOU

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ACKNOWLEDGEMENTS

- Mr. TAMIL SELVAN
- Mr. ARUN
- Mr. AZIZ
- MS. ANURUPA MAHATA