Treatment Planning of Complex Cases: Strategies and Tradeoffs

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Outline
- What makes a case complex?
- How do we sort and approach complex cases
- Case 1. Anal Canal and Prostate Bed
- Case 2. Bilateral Breast
- Case 3. Maxillary Sinuses

What Makes a Case Complex?
- Lack of communication in the team
- Simulation and planning image quality
- Volume delineation
- Limitations on beam directions
- Anatomical site
- Critical organ dose limitations
- Planning algorithms
- Length of treatment
- Setup reproducibility
- Anatomy constancy
- 4D related issues

Lack of Communication
- Preparation instructions to patients for simulation day
- Simulation instructions to CT tech
- Setup instructions to dosimetry and therapy
- Physician treatment intent
- Patient start time
- Physics responsibilities
- Ongoing care change orders
- Communications to outside information sources
Simulation and Planning image quality.
Volume delineation

<table>
<thead>
<tr>
<th>Issue</th>
<th>Tradeoff</th>
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</thead>
<tbody>
<tr>
<td>Missing information from simulation</td>
<td>Higher dose to Pt and higher cost of equipment</td>
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<tr>
<td>simulation-larger scan length, larger bore</td>
<td></td>
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<tr>
<td>Target and critical organ delineation</td>
<td>More complex planning, multiple optimization volumes and cost functions</td>
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<td>– overlapping volumes</td>
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<td>Imaging artifacts, HU calibration,</td>
<td>More time on algorithm QA and verification</td>
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<td>conversion to ( p_\text{eq} )</td>
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<tr>
<td>Patient preparation</td>
<td>Will lead to non-reproducible setup</td>
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</tbody>
</table>

Planning Limitations

- Limitations on dose coverage due to:
  - Beam directions
  - Anatomical site
  - Critical organ dose limitations
- Planning algorithms, how good is yours?
  - Hot spots, fake OARs, etc.
- Presenting plan for review
  - Better modeled, but "worse looking"
  - Lung, new way to Rx?
- Applicable to Brachytherapy

Geometric Limitations

- Length of treatment
  - Better targeting – more time, more dose
  - Longer delivery – different RBE, patient motion, setup change
- Setup method sensitivity and reproducibility
  - Setup and imaging methods
- Anatomy constancy due to:
  - Tumor response to Tx
  - Daily variations
- 4D related issues
  - CBCT for lung – what to line up ITV to?
  - Dose calculations on all phases?
- Particle therapy

Further Complications
Sensitivity to roll

Approach

- Identify where the complication is
  - Mental: Fortunately can consider it outside of planning
  - Initial patient preparation
  - CT simulation
  - Multimodality imaging
  - Beam placement
  - Calculation algorithm reliability
  - Verification
  - Treatment setup

- Once labeled the case moves into a category of “interesting” rather than “complicated”

Case 1

- ICD9 154.2 Squamous carcinoma. Anal canal, post-prostatectomy. T1NXMX
- Curative intent
- Total of 5 physician intents with differential dosing of the treatment sites
- Communication was a key to success
PTV 6, BEV

Optimization

Optimization

Composite Dose
How to address this? Adaptive approaches?

Prostate deformation caused by rectal filling.

Case 2

- Bilateral Breast with Supraclavicular involvement
- Would be an average case
- However…

Image Quality

Problems with Calculations
Volumes and Values

Composite

Anatomy Constancy
Case 3

- Maxillary Sinuses
- Proximity of critical organs
- Minimal margins
- Daily setup

Beam Positioning

Resulting Coverage
Conclusion

- Any case can be as complicated as you allow it to be
- Proper tools are required to address issues affecting all steps of planning process
- Multidirectional communication channels should be kept open between all teams

Thank You

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