Discussant for Protons in Lung Cancer

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Disclosure

Objectives of Radiation Therapy

- Primary: Maximize local tumor control
- Secondary: Minimize normal tissue effects

Maximize tumor control - lung

- X-rays
  - Local control is poor with 60-66 Gy
  - Are recent applications better?
    - Dose escalation
    - IMRT
    - IGRT
- Protons
  - Unknown local control vs x-rays
  - Greater uncertainty of dose hitting target

Minimize toxicity - Lung

- X-rays
  - Known normal tissue tolerances
  - Lung is fairly sensitive to low doses of XRT
- Protons
  - Probably advantageous for normal tissue avoidance
  - Except for tissues that are near the distal falloff!

Stage I NSCLC - ASTRO 2009

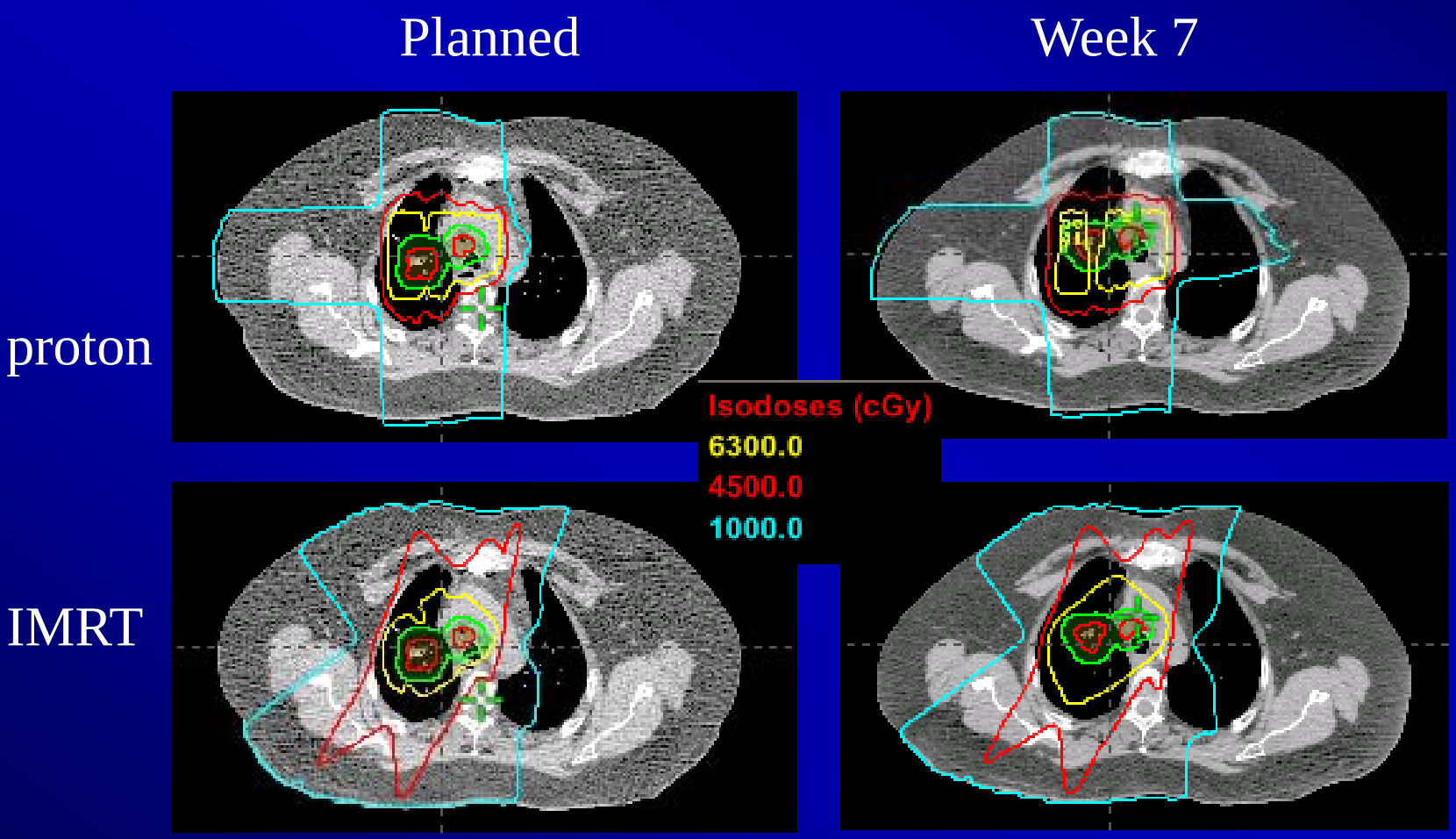
- Local control rates
  - SBRT photon (Cooperative group data) = >90% at 2 years
  - Proton/Carbon ion = 83% at 3 years

Prospective trials are important!

Uncertainties of proton dose in lung

- Tissue-air interfaces
  - Tumors near mediastinum and liver
  - Too much dose to esophagus?
- Target changes
  - Tumor Motion
  - Tumor Response
    - Shrinkage, central necrosis, etc.

CTV coverage drops from 99% to 92.3% with proton but not in IMRT



(Hui and Chang et al: Int J Rad Onc Biol Phy. 2008 in press)

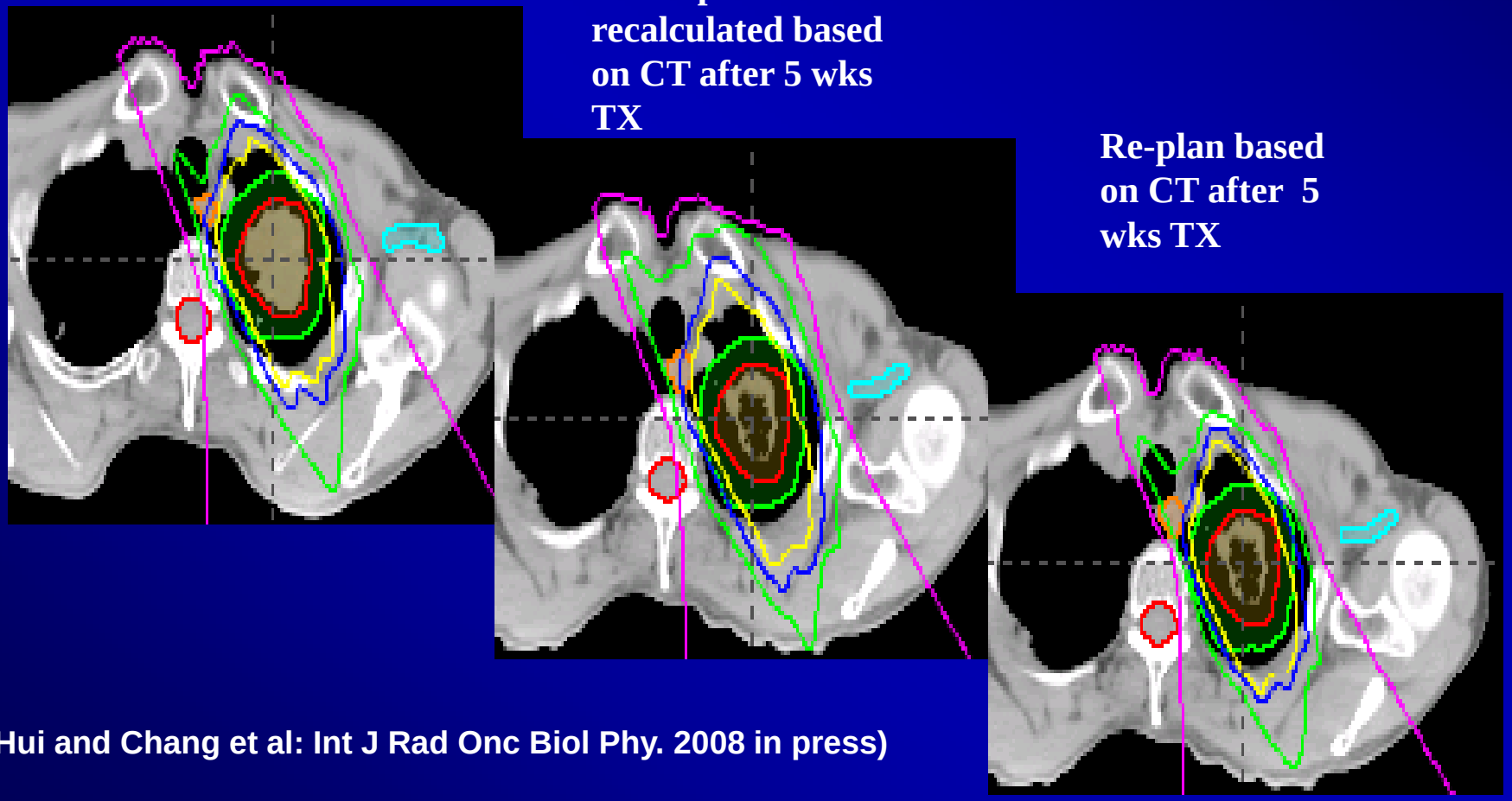
Adapted proton therapy

87.5 CGE in T2N0M0 NSCLC

Initial plan

Initial plan recalculated based on CT after 5 wks TX

Re-plan based on CT after 5 wks TX



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PTV concept is different for protons

- PTV margins
  - Optimally a PTV is generated for each beam
    - Concentric PTV margins are inadequate
    - Lateral margins different than proximal and distal
  - Creates problem for dose reporting
    - ICRU recommends different PTV margins for treating vs reporting

Summary

- X-ray dose uncertainties are fairly well known
  - Trials underway for dose escalation, IMRT, and IGRT
- Protons likely result in lower normal tissue dose (i.e. less toxicity)
- Tissue interfaces, tissue inhomogeneity, and target motion make dose delivery more complicated for protons
  - No satisfying local control results yet
  - Important to perform prospective clinical trials!