#### **Clinical Trial Personalizing Radiation Therapy Through a Novel Lung Function Imaging Modality**

**AAPM NIH Investigator Scientific Highlights** 

Yevgeniy (Jenia) Vinogradskiy, PhD



University of Colorado Cancer Center

# **NIH Funding Information**

- Clinical Trial Personalizing Radiation Therapy Through a Novel Lung Function Imaging Modality
- NCI: PAR-14-166: Early Phase Clinical Trials in Imaging and Image-Guided Interventions (R01)
- PI: Yevgeniy Vinogradskiy

**Co-investigators** 

- CU: Brian Kavanagh, Moyed Miften, Leah Schubert, Phillip Koo (radiology), Derek Linderman (pulmonology)
- Beaumont Health System: Edward Castillo, Thomas Guerrero
- UT Galveston (now Emory University): Richard Castillo
- Submission History: 8<sup>th</sup> percentile, first submission

#### 4DCT-Ventilation

- 4DCT acquired for simulation (reduced time, cost, dose)
- Anatomical + Functional information
- Good spatial resolution





#### Functional radiotherapy with 4DCT-Ventilation

- Use patients 4DCT data to generate ventilation image
- Use 4DCT-ventilation image to generate functional avoidance plan
- Hypothesis: 4DCT-ventilation functional avoidance will lead to reduced rate of radiation pneumonitis
- Clinical trial to evaluate 4DCT-ventilation functional avoidance



### **Clinical Motivation/Significance**

• Radiation pneumonitis is a major limitation in thoracic radiotherapy



# **Preliminary Data**

- Validation of 4DCT-Ventilation
- Functional avoidance feasible without sacrificing target/OAR goals
- Dose+function better predictor of pneumonitis than dose alone



#### Vinogradskiy et al



### **Relevant Prior Experience**

- PhD topic in radiation pneumonitis/Clinical toxicity
- Collaboration with relevant research team
- Experience writing a clinical trial
- 2-3 papers on the topic



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Physics Contribution

Investigation of the Relationship Between Gross Tumor Volume Location and Pneumonitis Rates Using a Large Clinical Database of Non-Small-Cell Lung Cancer Patients

Presented in part at the annual American Society for Radiation Oncology meeting, November 2010 October 31 - November 3, 2010, San Diego, CA.

Yevgeniy Vinogradskiy M.S. <sup>\*</sup> A ⊠, Susan L. Tucker Ph.D. <sup>†</sup>, Zhongxing Liao M.D. <sup>‡</sup>, Mary K. Martel Ph.D. <sup>\*</sup>

## **Specific Aims**

- Clinical trial to evaluate 4DCT-ventilation functional avoidance in clinical trial for lung cancer patients
- Specific aim 1: Evaluate clinical toxicity of functional avoidance radiation therapy
- Specific aim 2: Treatment assessment using imaging and functional biomarkers
- Specific aim 3: Identify quantitative imaging biomarkers that predict for clinical toxicity:
- Implicit aim: Open + Complete a clinical trial

#### Key Scientific Outcomes

- Trial successfully opened at CU, William Beaumont, Denver VA
- 92 patients consented in 2.5 years

### **Key Scientific Outcomes**

- Trial met pneumonitis futility criteria and progressed to stage II of accrual
- How to practically implement functional avoidance
  - Who can benefit
  - Workflow/QA
  - Treatment planning



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Imaging to Prevent Radiation Sequelae

Interim Analysis of a Two-Institution, Prospective Clinical Trial of 4DCT-Ventilation-based Functional Avoidance Radiation Therapy

Yevgeniy Vinogradskiy PhD \* A ⊠, Chad G. Rusthoven MD \*, Leah Schubert PhD \*, Bernard Jones PhD \*, Austin Faught PhD<sup>†</sup>, Richard Castillo PhD<sup>‡</sup>, Edward Castillo PhD<sup>§</sup>, Laurie E. Gaspar MD, MBA \*, Jennifer Kwak MD<sup>II</sup>, Timothy Waxweiler MD \*, Michele Dougherty PhD<sup>¶</sup>, Dexiang Gao PhD<sup>#</sup>, Craig Stevens MD, PhD<sup>§</sup>, Moyed Miften PhD \*, Brian Kavanagh MD, MPH \*, Thomas Guerrero MD, PhD<sup>§</sup>, Inga Grills MD<sup>§</sup>

## **Key Questions**

- What happens when primary trial physicist goes on vacation?
- Stability/Variability of image generation technique?
- What other factors effect toxicity?





Edward Castillo<sup>1,2</sup> · Richard Castillo<sup>3</sup> · Yevgeniy Vinogradskiy<sup>4</sup> · Thomas Guerrero<sup>1</sup>



#### Durvalumab after Chemoradiotherapy in Stage III Non–Small-Cell Lung Cancer

S.J. Antonia, A. Villegas, D. Daniel, D. Vicente, S. Murakami, R. Hui, T. Yokoi, A. Chiappori, K.H. Lee, M. de Wit, B.C. Cho, M. Bourhaba, X. Quantin, T. Tokito, T. Mekhail, D. Planchard, Y.-C. Kim, C.S. Karapetis, S. Hiret, G. Ostoros, K. Kubota, J.E. Gray, L. Paz-Ares, J. de Castro Carpeño, C. Wadsworth, G. Melillo, H. Jiang, Y. Huang, P.A. Dennis, and M. Özgüroğlu, for the PACIFIC Investigators\*

### Future research directions

- What happens when primary trial physicist goes on vacation?
  - Partner with vendor to produce a commercial grade image generation software
- Stability/Variability of image generation technique?
  - Improve image generation robustness
- What other factors effect toxicity?
  - What does functional avoidance look like in the setting of chemoRT+IO



#### Grant Advice for AAPM Members

- Keep applying (my funding success 4/28 = 14%)
- Range of ideas are suitable for grant applications

## Thank you



#### **University of Colorado**

Austin Faught PhD Leah Schubert PhD Bernard Jones PhD Moyed Miften PhD Laurie Gaspar MD Chad Rusthoven MD Brian Kavanagh MD, MPH

#### William Beaumont Hospital

Michele Dougherty PhD Edward Castillo PhD Craig Stevens MD Inga Grills MD Thomas Guerrero MD, PhD

#### Emory University Richard Castillo PhD

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