Innovation in IO: Radiogenomics, Artificial Intelligence, and Machine Learning

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Disclosures

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Radiogenomics: Definitions

- **Genomics:** elucidating the relationship between **complex disease** (such as cancer) and **a person's gene interactions and environment**
- **Radiomics:** extracting **quantitative and qualitative data** from **diagnostic imaging**
- **Radiogenomics:** integrating **genomic**, **radiomic**, and **clinical** data for the purposes of **predictive modeling**
- → **Precision oncology** and **targeted therapy**

Balmain A, et al. *Nat Genet*. 2003;33 Suppl:238-44. Lam A, et al. *J Vasc Interv Radiol*. 2018;29(5):706-713. Prasad V, et al. *Lancet Oncol*. 2016;17(2):e81-e86. Slovak R, et al. Digestive Disease Interventions, 2020. 04(01): p. 053-059.

Artificial Intelligence: Definitions

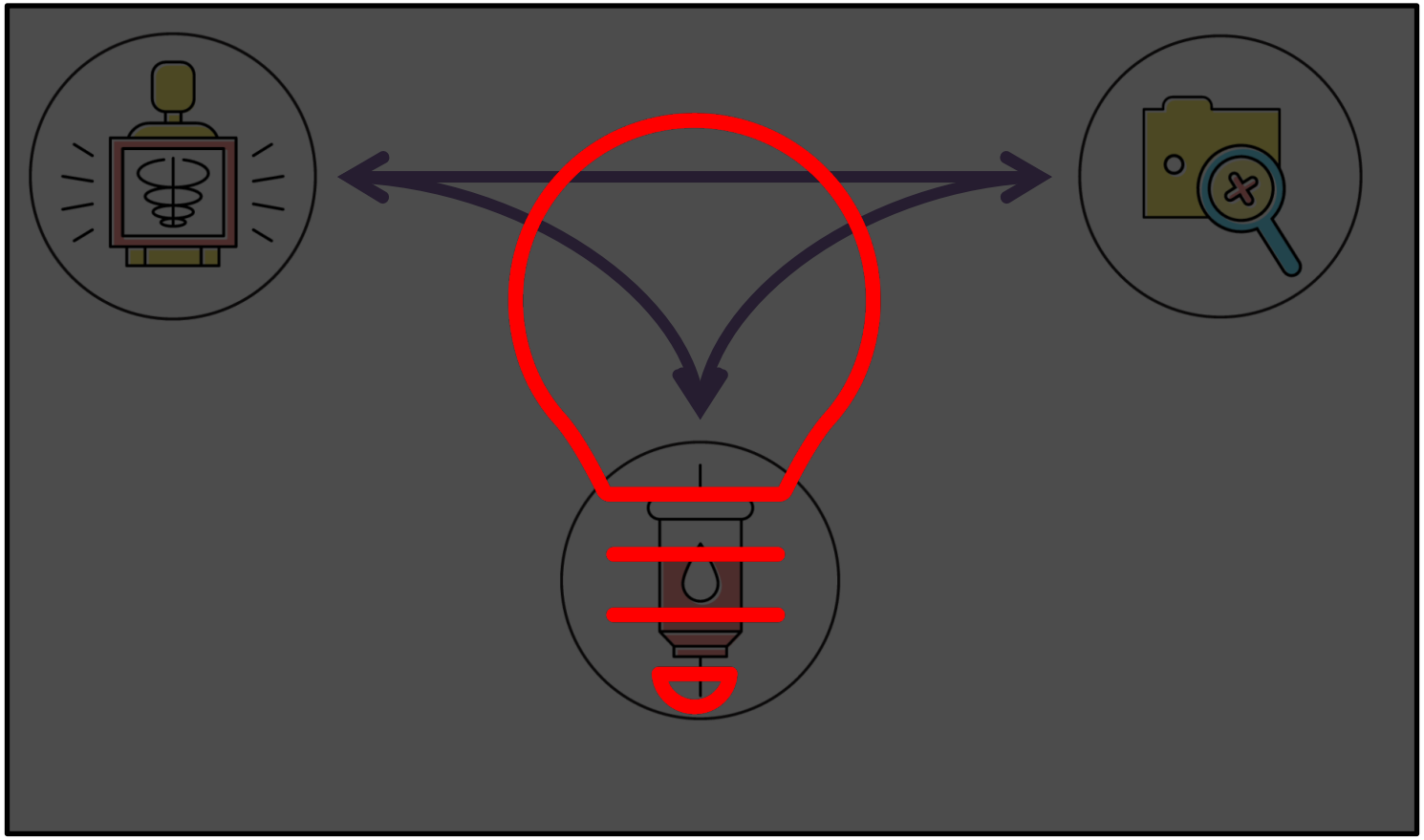
- **Artificial Intelligence:** computers **mimicking** human behavior
- **Machine Learning:** AI technique that allows computers the ability to learn **without being specifically programmed** to do so
- **Deep Learning:** type of machine learning using computational efforts over **multilayer neural networks**

https://blogs.oracle.com/bigdata/difference-ai-machine-learning-deep-learning

What Are the Challenges?

- **Massive data set**
  - Ideally suited for **artificial intelligence** and **machine learning**
- **Data quality & validity**
  - **Signal** versus **noise**
  - **Quantitative data**
  - **Qualitative data**
  - → **Standardization essential**

How Does This Work?



Examples – Hepatocellular Carcinoma

- **Microvascular invasion** more likely with CT findings of:
  - Internal arteries
  - Hypodense halos
  - Non-smooth tumor margins
  - Peritumoral enhancement on CT
- **Post-TACE complete response** associated with:
  - Tumoral heterogeneity
  - Tumoral attenuation
- **Association ≠ Causation**

Renzulli M, et al. *Radiology*. 2016;279(2):432-42. Park HJ, et al. *AJR Am J Roentgenol*. 2017;209(4):W211-W220.

Examples – Metastatic Neuroendocrine Tumor

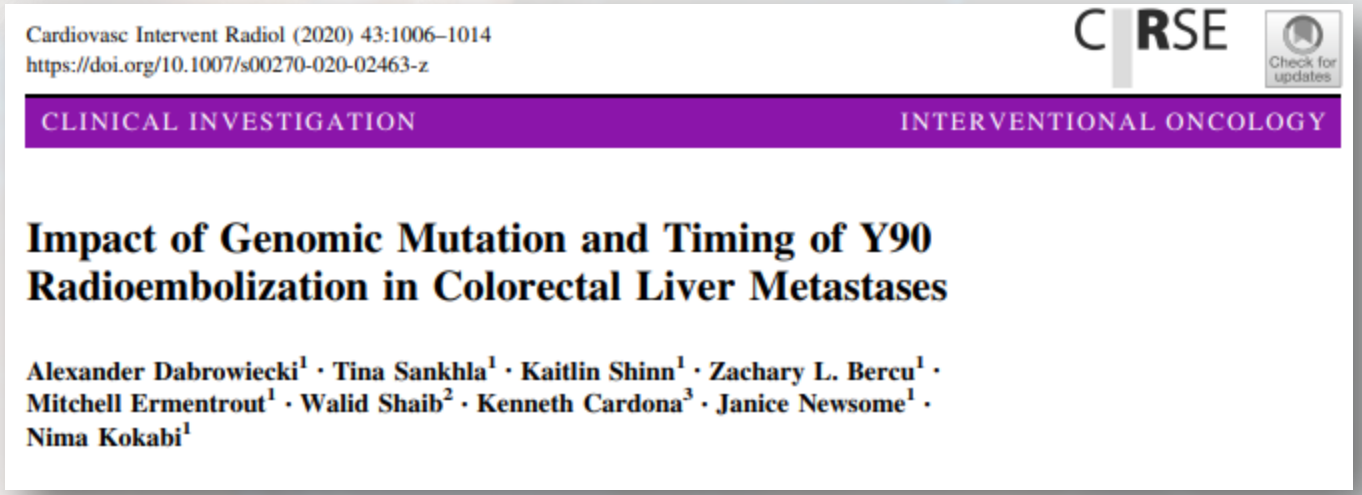
GASTROINTESTINAL (NONCOLORECTAL) CANCER

Evaluation of Ki67 and other predictors of survival in metastatic neuroendocrine tumor (NET) to the liver treated with Y90 radioembolization.

Julie Cronan, Bernadette White, Robert Mitchell Ermentrout, Zachary Louis Bercu, Walid Labib Shaib, Janice Newsome, Nima Kokabi

Emory University School of Medicine, Atlanta, GA; Emory University, School of Medicine, Atlanta, GA; Winship Cancer Institute, Emory University, Atlanta, GA; Interventional Radiology and Image Guided Medicine, Winship Cancer Institute, Emory University School of Medicine, Atlanta, GA

Examples – Metastatic Colorectal Cancer



Cardiovasc Intervent Radiol (2020) 43:1006–1014
https://doi.org/10.1007/s00270-020-02463-z

CIRSE

Check for updates

CLINICAL INVESTIGATION INTERVENTIONAL ONCOLOGY

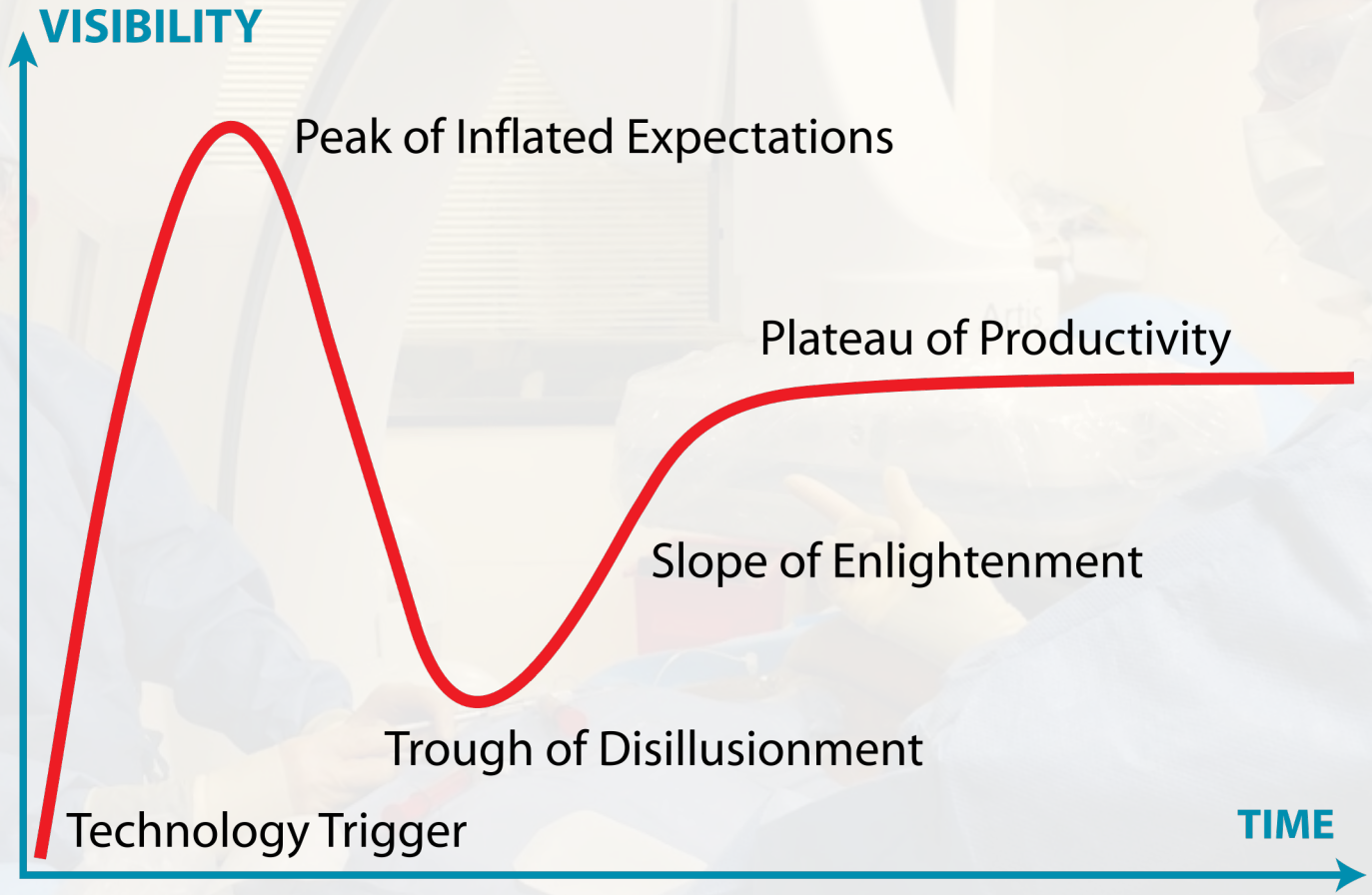
Impact of Genomic Mutation and Timing of Y90 Radioembolization in Colorectal Liver Metastases

Alexander Dabrowiecki[1] · Tina Sankhla[1] · Kaitlin Shinn[1] · Zachary L. Bercu[1] · Mitchell Ermentrout[1] · Walid Shaib[2] · Kenneth Cardona[3] · Janice Newsome[1] · Nima Kokabi[1]

Role of the Interventional Radiologist

- **H&P** → facilitates determination of **environmental factors**
- **Imaging** → determines **radiomic phenotype**
  - Pre-procedure (CT, MRI, PET)
  - Intraprocedure (angiography, CBCT, newer technologies)
- **Tissue** → **biopsy** (histopathology) is critical!
- **Follow-Up** →
  - What happened to the **tumor**?
  - What happened to the **patient**?
  - What happened to the **patient's quality of life**???

Where Are We?



https://upload.wikimedia.org/wikipedia/commons/9/94/Gartner_Hype_Cycle.svg

Take Home Points

- **IRs** are just at the **beginning** of this
- **Tissue biopsy** is **crucial**
- Need for **intentionality** and **thoughtfulness**
  - **Standardization**
  - **Focus on achievable outcomes**

Thank You

https://winshipcancer.emory.edu/images/location-imgs/emory-university-hospital-tower.jpg

https://www.midtownatl.com/_files/images/emory.jpg