Future of Quantitative Imaging Biomarkers (Radiomics) in Radiotherapy and Immunotherapy
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The Pan-omics of Oncology

Collect Specimen  
Screen Specimen  
Aggregate Data  
Analyze Data

Radiomics

A ‘new’ form of –omics
- Quantitative information from multi-imaging modalities (PET, CT, MR, etc) could be related to biological and clinical endpoints
- In oncology, it is decoding the Tumor Phenotype with Non-Invasive Imaging (Lambin, 2012)
Radiomics publications

Radiomics analysis

Radiomics Toolkits I: Imaging
**PET/CT from NSCLC local tumor**

Vaidya et al., RO '11

**PET/CT + Clinical for risk assessment in head & neck cancer**

Carrier Vallieres et al., Scientific report, 2017

**PET/MR fusion for Sarcoma mets to the lungs I**

Carrier Vallieres et al., PMB, 2015 (Rotblat Medal)

- A total of ~10,000 feature combinations were extracted from 51 patients
  - Scan fusion by
  - by Wavelet Transform
  - Feature selection by
  - Maximum relevance–minimum redundancy

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Radiomics offers new opportunities to develop better understanding of oncology processes and for personalizing therapy. Complementary information from hybrid (multi-modality) imaging (fused/separate) can enrich radiomics models and improve prediction power. Machine/deep learning techniques can improve feature selection and statistical learning in radiomics analytics and modeling outcomes. Proper integration of radiomics with clinical and other –omics (panomics) is necessary towards development of informed clinical decision support systems. Challenges for radiomics with machine learning methods include:
- Harmonization and optimization of image acquisition methods
- Validation and evaluation across independent datasets
- Better interpretation of radiomics models is still lagging.

Conclusions