THE EMERGING POTENTIAL OF RADIOMIC BIOMARKERS IN ONCOLOGY CLINICAL TRIALS

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Imaging to determine response and outcomes of therapy is a standard part of our therapeutic trials. Measurement of the tumor, typically by estimates of size, longest diameter, or volume, both at baseline and longitudinally, is perhaps the most important criterion of the success of therapy, both on trials and in standard practice. What is not usually appreciated in reviewing the image on the scan is that the actual image represents the summation of individual signals from tiny parts of the whole (pixels), and therefore contains a great deal more information than we can see with the naked eye. This information potentially contains structural and other components of the appearance of the tumor if it could be analyzed in detail.

Until recently, the enormous volume of data involved made such analyses challenging. However, in recent years this so-called radiomic analysis, namely the high-throughput extraction of radiologic imaging features, has become possible in several ECOG-ACRIN institutions, and is now incorporated in a scientific committee devoted to expanding its value to science in the Group. The rationale is that imaging non-invasively captures in-vivo patterns of heterogeneity for the entire tumor, providing complementary phenotypic information with prognostic and predictive value. This scientific activity is one of the pillars of our Big Data analyses in EA, and will be a focus of the First Robert L. Comis, MD Translational Science Symposium at our Fall 2019 Group Meeting in Fort Lauderdale, Florida. The Radiomics Committee is co-led by Dr. Habib Rahbar MD, Associate Professor of Radiology at the University of Washington and myself. Trials incorporating such endpoints are being analyzed, including radiomic markers of DCIS aggressiveness (E4112). The goal is to leverage computational analysis of routinely acquired multi-modality imaging to provide rapid, non-invasive, and relatively inexpensive imaging biomarkers that can augment precision therapy for patients diagnosed with cancer.

A recent initiative of the EA Radiomics Working Group is a group concept proposal submission to perform radiomic analysis of the NCI-MATCH trial data. This concept will be discussed in the Radiomics Working Group Session, which is open to all ECOG-ACRIN members. The analysis of the imaging data collected in the NCI-MATCH protocol provides a unique opportunity to perform unprecedented radiomic-genomic correlative analyses. Images acquired in patients that were screened, but did not go on study arms, will be used for primary analysis. About 75% of imaging data available are CT scans, while additional modalities including US, PET, and MRI will be used when available. A review of the available imaging data would indicate there are at least 4,620 cases that would meet criteria for analysis. To maximize efficiency in data sharing among participating investigators, all lesion annotations will be uploaded in a commonly accessible data repository using the ACR DART platform. To extract radiomic signatures from the MATCH trial data, segmented lesions will be analyzed for a full spectrum of high-throughput extraction of radiomic features. Investigators will explore a breadth of cutting-edge algorithms to extract a range of radiomic descriptors and will be also able to implement and test custom AI algorithms, including machine learning and deep-learning methods (such as the one presented by Drs. Lehman and Barzilay in the General Session). The extracted radiomic descriptors will be correlated to the available genomic data collected by the NCI-MATCH protocol, including all genes tested by NCI-MATCH’s Customized Thermo Fisher OncomineTM panel. Secondary analysis will expand the work proposed to include available digital pathology images.

While related statistical and machine learning methodologies are still in development, the important question that the radiomics community needs to address is to which extent imaging phenotypes can provide additional information to current histopathologic and emerging molecular assays to ultimately augment clinical decision making for guiding precision therapy of cancer. ECOG-ACRIN is uniquely positioned to move the field forward in this direction. To this end, it is important to adopt common standards for the extraction of radiomic biomarkers (efforts currently in process by the Quantitative Imaging Network) to mitigate effects of the continuously evolving imaging technology, promote data sharing practices to accelerate independent validation and generalizability of findings, and foster transdisciplinary collaborations to enable the evaluation of radiomic biomarkers in prospective, ideally randomized, oncology clinical trials.