Abdominal Radiology (2019) 44:1959
https://doi.org/10.1007/s00261-019-02047-7

EDITORIAL

Reflections on radiogenomics and oncologic radiomics

Meghan G. Lubner[1]

Published online: 9 May 2019

With the rise of precision medicine and growing number of targeted treatment options for cancer, there has been dramatic growth in the amount and type of information we would like to extract from individual patients and tumors. Biomarkers in the laboratory have helped validate hypotheses across a number of different tumors; imaging data have been a key biomarker both for trial design and assessment of efficacy. Radiomics allows high-throughput extraction of quantitative features used to convert images into mineable data. This exploding field attempts to capture and quantify a wide variety of parameters in the image and translate these findings into distinct imaging phenotypes. Oncologic radiomics, as we are using it in this special issue, is a method for extracting imaging features that may be descriptive of tumor pathologic features, tumor behaviors, or clinical outcomes for a spectrum of tumor types. As stated by Elkarghali et al in their review in this issue, radiomics in general, is a method, while radiogenomics is a specific application of "oncologic radiomics" which uses imaging features to non-invasively identify or predict specific genomic alterations in the tumor (e.g., KRAS mutation status) that may impact tumor behavior or the way a tumor responds to treatment. Although technically not radiogenomics, these methods can be extrapolated into proteomics or metabolomics, as described by Scrima et al. and Shih et al. in this issue. Biopsy has been the mainstay of determining these features currently; however, it is expensive, invasive, and assesses only the sampled section of a heterogeneous tumor. Non-invasive imaging assessment of the whole tumor or of a multi-focal tumor burden in a single patient has the potential to provide a more comprehensive look at the tumor and disease in a non-invasive way.

Classical radiomics may take a more "manual" or human-directed approach to the tasks described above, where a region of interest is manually or semi-automatically segmented, a group of features are extracted, and statistical models are used to look for associations between imaging and tumor features. An example of a classical radiomics tool is CT texture analysis, with definitions and potential applications in a variety of tumor types as discussed in multiple articles in this special section. With the rise of artificial intelligence, many groups are looking at the application of machine/deep learning to these types of tasks, where systems capable of learning from the data are constructed without specific human instructions much beyond lesion localization. There are potential advantages to machine learning models, in that they can extract larger numbers of features, are often built from more comprehensive datasets, and make fewer mathematical assumptions. However, the features utilized in a machine learning model can be a bit of a black box, and further elucidation of the details behind some of these models are still being investigated. These concepts are discussed in more detail by Elkarghali et al.; while Raman et al. and Zhong et al. apply these types of models in renal cell and prostate carcinoma, respectively.

Many of these radiomics tools have not yet entered the clinical mainstream for oncologic applications, and there are many persistent challenges that we as clinicians need to address to move this field forward, as discussed by Dr. Ron Summers' editorial. It is essential that we continue to critically assess and refine these tools using large, multi-institutional datasets and work to establish associations with *clinically relevant* genes, pathologic features, and outcomes.

Despite its limitations, percutaneous biopsy, for the present, remains an important tool in characterizing tumors and directing patient management. Cherukuri et al. and Boyum et al. offer data on the impact of precision medicine on percutaneous biopsy procedures and the downstream quality and safety considerations.

Please enjoy this special section on oncologic radiomics and radiogenomics. Although we are only able to scratch the surface of this large and expanding body of literature, we hope you will be interested in learning more. As radiologists, we must remain not only informed on but also engaged with and actively driving this rapidly changing and growing field.

✉ Meghan G. Lubner
mlubner@uwhealth.org

[1] Department of Radiology, University of Wisconsin School of Medicine and Public Health, E3/311 Clinical Sciences Center, 600 Highland Ave, Madison, WI 53792, USA