Integrated Diagnostics Prostate Research Program: An Interdisciplinary Approach to Better Understand the Nature and Biology of Cancers

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BACKGROUND

Integrated Diagnostics (IDx) is an interdisciplinary program, an undertaking by the departments of Radiological Sciences & Pathology and Laboratory Medicine to integrate sophisticated imaging with histopathology and molecular diagnostics to better understand the nature and biology of cancers. The initiative includes patient accrual, data acquisition, bio-specimen collection and archival of all clinical and imaging data for qualifying patients. The repository creates a common framework for facilitating the collection, extraction, annotation, and dissemination of patient data across a variety of data sources (such as clinical, imaging & pathology). The data repository is meant to be comprehensive, providing researchers with the ability to identify unique cohorts across clinical, imaging, and molecular data and to generate hypotheses. To enable that, the program has established an honest broker process for investigators to request and gain access to data extracts on these individuals for secondary use to benefit the educational and research efforts. Appropriate consents and institutional review board approvals have been put in place for all bio-specimens, data archival & distribution. Presently, clinical domains include but are not limited to prostate, lung, breast, kidney, and liver.

EVALUATION & RESULT

The flow diagram (Figure 1) illustrates the process used in Prostate IDx. Following multi-parametric (mp) MR imaging and biopsy, the mpMR features are correlated with PI-RADs and clinical outcomes. Patients undergo a prostatectomy, based from which the Gleason score and pathologic stage are determined. From the resected prostate, whole-mount specimens are created, which are used to correlate histology with imaging features in multidisciplinary meetings. The research platform consists of two primary components: 1) a data entry and matching interface, which permits research associates to enter new patient cases (demographics, clinical history, imaging, and pathology information), extract targets, and map between radiology targets and pathology lesions; and 2) an interactive dashboard that facilitates querying and descriptive analysis of the captured data. The platform currently hosts clinical, imaging and pathology data for 701 patients, including 932 lesions (593 index lesions) detected on MRI and 1414 lesions identified in WM specimens. The matching algorithm detected 750 true positives (where imaging and pathology targets match), 188 false positives (where radiology targets were not confirmed by pathology) and 695 false negatives (where targets not detected on MRI were identified by pathology).

One such corollary example of the initiative is the recent development of a new system to align multiple scales of information – in vivo pre-surgical MRI, high-resolution quantitative ex vivo prostate specimen MRI, and whole-mount (WM) histopathology (reference & Figure 2). The system involves creating a patient-specific 3D printed prostate mold from in vivo MRI, which is used for ex vivo imaging right after the resection and then used promptly to section and process the histopathology WM slides. This new

system may be used to establish an accurate spatial correspondence between mpMRI data and histopathology to develop and validate improved mpMRI acquisition and image analysis techniques for prostate cancer diagnosis.

CONCLUSION

Integrated diagnostics program plays a critical role in ongoing cancer research, enabling the cutting-edge research that is being undertaken by investigators across Radiological Sciences and Pathology & Laboratory Medicine and the broader David Geffen School of Medicine community.