BIOMARKERS

Raman microscopy for the identification of an aggressive variant of prostate cancer, intraductal carcinoma of the prostate


1Pathology and Cellular Biology, Université de Montréal, Montréal, QC, Canada, 2Axe Cancer, Centre de recherche du Centre hospitalier de l’Université de Montréal, Montréal, QC, Canada, 3Urology, Hospital St. Luc du CHUM, Montréal, Canada, 4Pathology, Centre Hospitalier de l’Université de Montréal (CHUM), Montréal, QC, Canada, 5Genetics, Ontario Institute for Cancer Research, Toronto, ON, Canada, 6Cancer Sciences, Cancer Research UK Manchester Institute, Manchester, UK, 7Pathology, Toronto General Hospital, Toronto, ON, Canada, 8Laboratoire d’Uro-Oncologie Expérimentale, CHU de Québec-Université Laval, Quebec, QC, Canada, 9Oncologie, CHU de Québec-Université Laval, Québec, QC, Canada

Background: Prostate cancer (PC), initially diagnosed on biopsies by pathologists, is the most frequent cancer in North American men. However, better tools are needed for pathologists to diagnose intraductal carcinoma of the prostate (IDC), an aggressive histopathological variant of PC for which therapeutic options are now available. Indeed, no technique or biomarker is clinically available to support the diagnosis of IDC. Raman spectroscopy (RS) provides a global molecular characterisation of the tissue by analysing how photons interact with the molecules present in the tissue. Indeed, we and other groups previously used RS to detect cancer from multiple organ types, machine learning classification models being employed to process the complex Raman data.

Methods: We used Raman micro-spectroscopy (RµS) to detect IDC on tissues from 483 first-line radical prostatectomies from three Canadian institutions. Following a rapid, standardized and low-cost protocol, we acquired an average of 7 Raman spectra per patient and generated classification models using machine learning technology. Importantly, models were trained with data from one institution before independent testing on the data from the other two institutions.

Results: The three institutions included 272, 76 and 135 patients. Median age at diagnosis ranged from 61-62 years-old, with median pre-operative PSA ranging from 6.6-7.4 µg/L. Most patient had ≤3 + 4 Gleason score (60-80% of the specimens) and pT3-stage incidence was 31-55%. IDC was identified in 6-18% of the patients of each cohort. Overall, we acquired an average of 7 Raman spectra per patient. In the training cohort (N = 272), RµS identified IDC with a sensitivity of 95%, a specificity of 94% and an...
accuracy of 94%. Results from the testing cohort were in a similar range, with sensitivities of 88 and 92%, specificities of 83 and 91% and accuracies of 85 and 91%.

Conclusions: As clinically available biomarkers of IDC have reported sensitivities/specificities of ~80%, we here identified IDC with accuracies ≥85%. Since our classification model was trained on a cohort and independently tested on the other two, these are likely to be close to real life experience making clinical implementation a realistic outcome.

Legal entity responsible for the study: The authors.

Funding: Centre de Recherche du Centre Hospitalier de l’Université de Montréal (CRCHUM, continuum program) IVADO, Institut de valorisation des données.

Disclosure: All authors have declared no conflicts of interest.