

Artificial Intelligence-based Detection of Neuroendocrine Carcinoma of Prostate in Metastatic Biopsies

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Background

Neuroendocrine prostate carcinoma (NEPC) is a high-grade carcinoma with aggressive disease behavior, which the diagnosis is based on characteristic histology features similar to those seen in small cell carcinoma of the lung. We have previously developed a deep-learning based supervised learning algorithm using localized high grade prostatic adenocarcinoma with NEPC component as training set, and modified it to apply to metastatic castration resistant prostate cancer (mCRPC).

Methods

We tested the algorithm in 62 metastatic prostate cancer biopsies at University of California, San Francisco (UCSF), including 15 cases (~24%) of NEPC determined by morphology and further supported by immunohistochemistry (Synaptophysin, INSM1, chromogranin A) and genomic profiling. Each slide is assigned with a NEPC score (0-1, 1 represent highest confidence of NEPC by AI). The result is also comparing to Ki-67 proliferation index of each slide.

Results

The NEPC score assigned by AI based on H&E slide alone is highly associated with overall diagnosis of NEPC ($p \leq 0.001$) and immunohistochemistry result ($p \leq 0.001$). The algorithm further successfully distinguish AR-/NE+ NEPC from AR+/NE+ ("double positive" or amphicrine carcinoma) ($p < 0.05$). In rare cases that human pathologists did not assign NEPC diagnosis due to lack of immunohistochemistry evidence but have high NEPC score by AI, those cases have high Ki-67 proliferation index and alteration in *TP53* and *RB*.

Conclusions

This is a proof of principle study for applying morphology-based AI tool in assist diagnosis of NEPC in metastatic setting. Additional studies with genomic and transcriptional classification as well as clinical outcome maybe helpful in developing this tool for clinical utility.

Funding Acknowledgements The work is supported by Prostate Cancer Foundation (Young Investigator Award and Challenge Award), AIRA Matrix (through Prostate Cancer Foundation) and UCSF Benioff Prostate Cancer Research Initiative.

Conflicts of Interest Disclosure Statement NC, UJ, and NS are employees of AIRA Matrix. TLL and ADM received funding support from AIRA Matrix through PCF.