AI-Power to the pathologist -

Immunofluorescence and IHC-guided annotations for precise deep learning segmentation of suspicious cancer in prostate core biopsies.

ContextVision

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Background:
Prostate biopsies represent a fair amount of the pathologist workload and, in addition, the diagnosis is subjective and suffers from high intra- and inter-observer variability.

To improve the consistency and objectivity in the grading and evaluation of prostate core needle biopsies, we have developed an AI-based decision support tool for pathologists to detect and outline neoplastic glandular tissue.

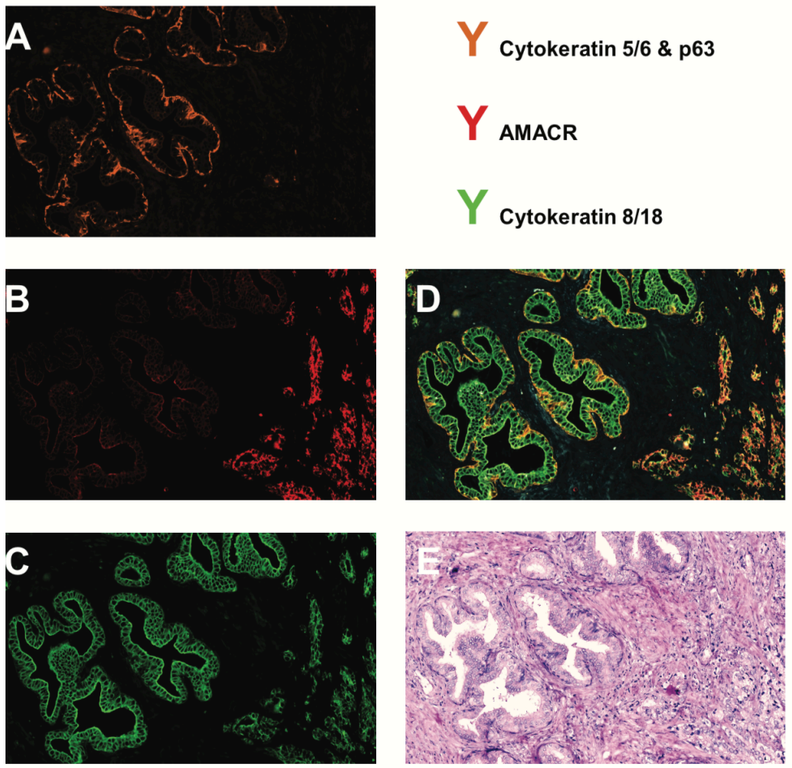

Figure 1: Prostate section stained with CK5/6 and p63 for basal cells (A), the cancer marker AMACR (B) and CK8/18 for epithelial cells (C). Overlay of all channels (D). Same section stained with HE (E).

Methods:
To reduce the turnaround time and improve the objectivity of our training and test data, we developed a patented multiplex staining method, MasterAnnotation™, to train our algorithms to detect and outline glandular tissue without basal cells (WOB).

Pathologists manually annotated WOB areas, as well as areas with intraductal cancer, in scanned H&E whole slide images as suspicious for cancer, assisted by aligned immunofluorescence or chromogenic IHC images. The UNet-based semantic segmentation algorithm, in INIFY® Prostate (ContextVision, Sweden) was developed within a deep learning framework developed in-house at ContextVision.

Cancer WSI's			Benign WSI's
Sensitivity	Specificity	F1	Specificity
0,977	0,989	0,962	0,998

Table 1: Median pixel-level performance statistics with a tolerance of 3 pixels (representing ~27 µm mm) on the 44 evaluated whole slide images (WSI) with cancer. Specificity on the 12 benign WSI's was also calculated.

Results and discussion:
The algorithm was evaluated on 56 prostate biopsies, stained at five different laboratories and scanned on three different scanners brands (Leica Aperio, 3DHistech and Hamamatsu). It achieved a median pixel-level sensitivity and specificity of 97.7% and 98.9%, respectively, on cancer images, and a specificity of 99.8% on benign images, using a tolerance of 3 pixels (or approximately 27 µm).

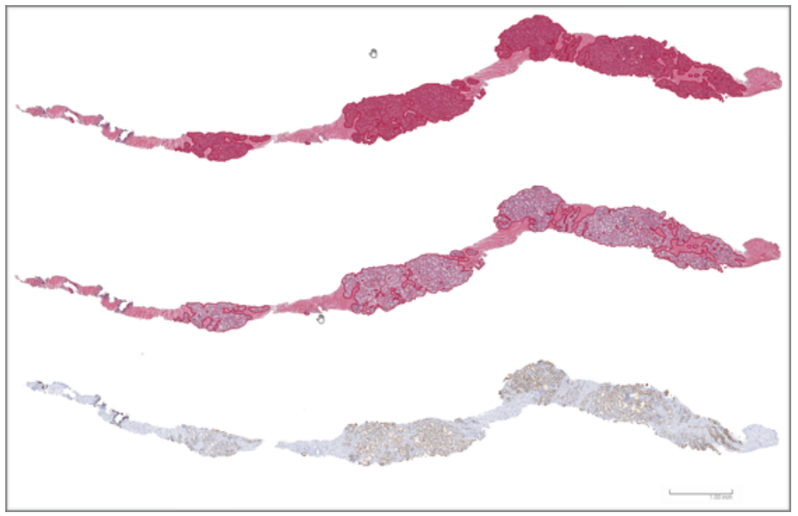

Figure 2: Filled (top core image) and outlined (middle image) prediction of "Suspicious" cancer areas in a core needle biopsy containing prostate cancer with Gleason pattern 3+4. For reference in and to calculate analytical performance consecutive IHC was performed. Light DAB staining is AMACR indicating cancer cells and dark staining is basal cells p63 in benign acini (lower core).

Conclusion:
Using this training methodology, we have developed INIFY® Prostate, a CE marked AI-based software that in a clinical setting, predicts, outlines, and quantifies suspected cancer areas in prostate biopsy H&E whole slide images.

INIFY® Prostate MasterAnnotation™