Artificial-Intelligence-Based Automatic Analysis of Urothelial Carcinomas – Our Experience

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Abstract
Diagnosing urothelial carcinoma (UC) is usually a quite simple task but requires thoroughly examination of several slides; cases with more than 10 slides are not uncommon. Thus, an automated method for histopathological analysis is more than welcome. We selected from our archives 105 patients (100 UC and 5 cystitis); we examined the slides and selected and scanned one slide/case, obtaining whole slide images (WSIs). We performed a pixel-per-pixel semantic segmentation of 21 selected areas/WSI for several classes (high-/low-grade tumor, invasion, emboli, stroma, vessels, smooth muscle, etc.). We trained an InternImage model on this data set; we used dice coefficient (DCC) and intersection-over-union (IoU) as metrics for our model performance. UC patients were predominantly males (72%), average age 66.04years, 46% low-grade UC/ 54% high-grade UC, 42% noninvasive/ 58% invasive (28%pT1 and 30%pT2 or above). There were, on average, 3.93 paraffin blocks/case (1-17 paraffin blocks/case). The data set obtained after annotation was arbitrarily separated in training (57.18%), validation (21.37%) and test sets (21.44%). The results on test set are: high-grade tumor (0.66 DCC/0.49 IoU), low-grade tumors (0.82 DCC/0.70 IoU), stroma (0.84 DCC/0.73 IoU), vessels (0.75 DCC/0.60 IoU) and LVI (0.77 DCC/0.62 IoU). We evaluated each patch of the test set; apparently low DCC and IoU scores are consequences of human inability in precise drawing of the classes and/or impossibility of annotation of very small vessels. Our model identifies high-/low-grade tumor, invasion, emboli, and smooth muscle and highlights them on a heat map. The pathologist analyses highlighted areas, thus shortening the time required by microscopic analysis. The results of our model are encouraging; its use improves the diagnostic accuracy, reduces the time taken for analysis, and potentially leads to better patient outcomes.

Keywords: Artificial Intelligence; Urothelial Carcinoma; Tumor Grade; Invasion.

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