

Automated Approach for Estimation of Grade Groups for Prostate Cancer based on Histological Image Feature Analysis

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Title : Automated Approach for Estimation of Grade Groups for Prostate Cancer based on Histological Image Feature Analysis
(組織画像特徴量分析に基づく前立腺癌のグレードグループの自動推定法)

Category : Kou

Thesis Summary

Background: There is low reproducibility of the grade group of prostate cancer due to the intra- and inter-observer variability among pathologists. This study aimed to develop an automated approach for estimating prostate cancer grade groups based on features obtained from histological image analysis.

Methods: Fifty-nine patients who underwent radical prostatectomy were selected under the approval of the institutional review board of our university hospital. For estimation, we followed the grade group criteria provided by the International Society of Urological Pathology in 2014. One hundred eight specimen slides obtained from the patients were digitized to extract 110 regions of interest (ROI) from hematoxylin and eosin stained histological images using a digital whole slide scanner at 20× magnification with pixel size of 0.4 μm. Each color pixel value in the ROI was decomposed into six intensities corresponding to the RGB (red, green, and blue) and HSV (hue, saturation, and value) color models. Image features were extracted by histological image analysis, obtaining 54 features from the ROI based on histogram and texture analyses in the six types of decomposed histological images. Then, 40 representative features were selected from the 324 histological image features based on statistically significant differences ($p < 0.05$) between the mean image feature values for high (≥ 3 , Gleason score $\geq 4 + 3$) and low (≤ 2 , Gleason score $\leq 3 + 4$) grade groups. The relationship between grade groups and the most representative image feature (i.e., complexity) was approximated using regression to estimate real-number grade groups defined by continuous numerical grading. Finally, the grade groups were expressed as the conventional grade groups (i.e., integers from 1 to 5) using a piecewise step function.

Results: The grade groups were correctly estimated by the proposed approach without errors on training (70 ROIs) and validation (40 ROIs) data

Conclusions: Our results suggest that the proposed approach may support pathologists during evaluation of grade groups for prostate cancer, thus mitigating intra- and inter-observer variability.

Keywords: Gleason score, International Society of Urological Pathology (ISUP), grade group, piecewise step function, histological image features.