POLARIZED LIGHT MICROSCOPY FOR QUANTITATIVE ASSESSMENT OF COLORECTAL CANCER: CAN WE PREDICT LOCAL RECURRENCE?

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Key Words: polarized light microscopy, Mueller matrix, polar decomposition, colorectal cancer, local recurrence

Colorectal cancer (CRC) is a prevalent oncologic malignancy worldwide, with up to 50% of patients experiencing local recurrence (LR) following primary curative surgical resection. The timely detection of LR is of utmost importance, as it has been demonstrated that aggressive treatment of localized disease can significantly prolong survival. In this context, peri-tumoural stroma architecture has been shown to play a critical role in cancer development, response to therapy and patient outcomes. Notably, the stroma is predominantly composed of collagen, an anisotropic fibrous component that exhibits strong interactions with polarized light, thereby offering abundant morphological information about biological tissue. Exploiting this characteristic, Mueller matrix (MM) polarimetry, a quantitative polarized light imaging technique, holds promise as a valuable tool for assessing cancerous tissue and potentially aiding in prognostication efforts. Thus, our study aims to evaluate the prognostic value of polarimetric characteristics within the collagenous stroma architecture. We conduct our analysis on 38 stage III CRC patient samples, utilizing MM polarized light microscopy on unstained histology slides (Fig. 1). By employing MM transformation and polar decomposition parameters, we assess their correlation with 5-year LR outcomes in patients. Our results reveal significant differences (p-value < 0.05) in certain polarimetric parameters between the recurrence and recurrence-free patient cohorts, as determined through the Mann-Whitney U test. MM parameters may thus be prognostically valuable towards improving clinical management/treatment stratification in CRC patients. However, further advancements and refinements are necessary to translate these promising results into potential clinical applications.

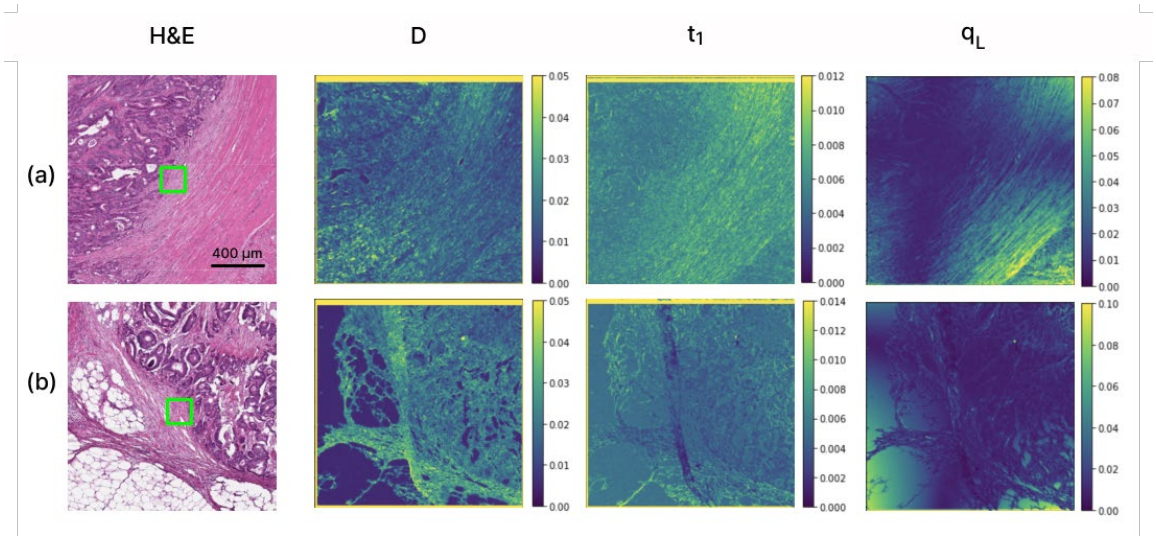

Figure 1 – Mueller matrix polarimetry of human stage III left-sided colorectal cancer. H&E, diattenuation (D), anisotropy degree (t_1) and linear-to-circular polarization conversion (q_L) images around a particular ROI (green boxes on the H&E) are shown; the former two columns report on tissue anisotropy, whereas the latter right-most column is sensitive to density and alignment of birefringent structures such as collagen. A representative ROI from: (a) a recurrence-free patient; (b) a patient whose colorectal cancer did recur locally within 5 years.