Machine learning aided analysis of SHG microscopy images of oesophageal squamous cell carcinoma progression and high-grade dysplasia

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Abstract:

The incidence of oesophageal cancer has doubled worldwide over the past two decades and is one of the top 10 causes of cancer death worldwide. Oesophageal cancers are diagnosed as oesophageal squamous cell carcinoma (ESCC) and oesophageal squamous dysplasia. During ESCC progression, the tumour cells consume the collagen fibres, leading to their disorientation in the submucosa. Non – linear optical microscopy techniques such as second harmonic generation (SHG) microscopy, two photon fluorescence (TPF) microscopy, third harmonic generation (THG) microscopy, etc are emerging techniques that are employed for the visualization of tissue microstructures in recent studies. Manual analysis and grading of tissue images is a tedious task and is time consuming. Besides, manual analysis is highly subjective and is prone to random errors. These limitations can be overcome with the integration of computational techniques such as machine learning (ML) for the classification and grading of images. The current study employs Grey Level Co-occurrence Matrix (GLCM) to extract textural features from the ESCC images, which were used for their classification by Support Vector Machine, a supervised ML algorithm. The study concludes that classification images by employing computational techniques such as ML is a faster method whose robustness can be improved by increasing the size and variability of the training dataset.