

## Differentiation of esophageal cancer tissues by polarization-resolved second harmonic generation microscopy

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### ABSTRACT

Esophageal cancer is the 8th most common form of cancer in the world, which is often diagnosed at a late stage due to how difficult detecting early cancerous changes can be when using conventional endoscopy and/or biopsy. To improve the diagnostics accuracy, circularly polarized second-harmonic generation (CP-SHG) imaging is employed to investigate the structural variation of collagen fibers, which are abundantly distributed in normal esophageal squamous epithelium. Because collagen molecule is formed with a triple-helical structure, it exhibits chiroptical effects when interacting with CP excitations [1]. Previous studies indicate that the structural change in collagen ascribes to misfolding of the triple helices that is highly associated with cancer cell invasion [2]. Thus, it is of great significance to study the structural correlation between collagen fibers and esophageal cancer tissues at varying stages.

In general, chirality is revealed by linear chiroptical spectroscopy, such as circular dichroism (CD). Nevertheless, it is suffered from low signal contrast and unable to perform depth imaging. By using CP-SHG imaging, not only the optical sectioning ability is provided but also the high contrast ratio of SHG-CD (i.e., defined as the intensity difference between left circularly polarized excitation (LCP) and right circularly polarized excitation (RCP), divided by their average) is [3]. With this technique, we demonstrate how to use the average value of SHG-CD as an indicator to define different stages of esophageal cancer tissues for the first time. This work is further confirmed by two-photon fluorescence imaging, which sets a good example of using nonlinear optical imaging to reach precise diagnosis on fatal diseases.

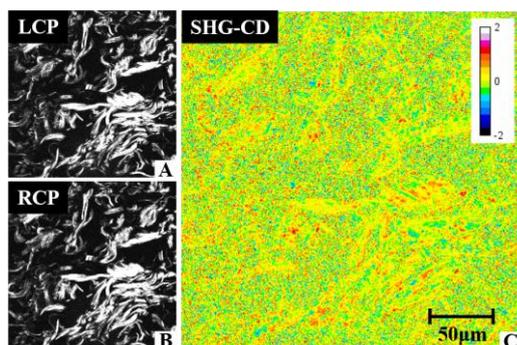


Figure 1: A and B show the SHG images of esophageal squamous cell carcinoma IV with LCP and RCP excitation, respectively. The SHG source is from type-I collagen around esophageal squamous cells. C represents the SHG-CD response calculated from A and B.

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