Laryngeal Vascular Tree Segmentation for Early Stage Tumor Detection

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Objectives: (1) Support clinicians during the diagnosis through an enhanced visualization of the vascular tree. (2) Guide clinicians with limited experience with Narrow-Band (NB) technology in recognizing altered vessel patterns. (3) Improve the detection of early-stage tumors, which is an arduous task given the small level of pathological alterations of the vasculature.

Methods: Twenty patients with moderate to severe laryngeal squamous cell carcinoma were included in this study. Each patient underwent a NB endoscopy. The proposed system was used to enhance the visualization of superficial blood vessels by automatically segmenting and increasing their contrast in the videoendoscopy frames. The image processing framework used consisted of: Anisotropic Diffusion for denoising, image Hessian analysis to enhance vessels and Support Vector Machines to obtain the vascular tree segmentation. The obtained segmentation results were numerically compared in terms of accuracy with the vessel manual delineation performed by an expert clinician.

Results: The vessel segmentation process achieved an overall accuracy of 0.832, which is higher than the values achieved by other methods in the literature (≤ 0.793). The enhanced videoendoscopy frames were presented to expert clinicians, who provided positive comments related to the quality and usefulness of the system for improving the visualization of both pathological and healthy vessels.

Conclusions: The proposed method has the advantage of enhancing laryngeal vascular tree evaluations without introducing any limitation or significant changes to the current videoendoscopy inspection practice. It can include suitable information, offering a simple visual support tool that assists the clinician in the recognition of altered vascular patterns.