An Automatic Quantitative Evaluation of Intercellular Spaces in Desmoglein-3 Stained Specimen Microscopic Images.

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Abstract

This paper presents automatic method for identification of dilated intercellular spaces (DIS) appeared in the esophageal epithelium in a course of GERD and used as one of the microscopic criterion of the disease severity. Some published studies carried on the electron microscopy biopsy samples have shown relation between DIS and response to treatment. According to the electron microscopy images the dilated spaces DIS are classified as "bubbles"- irregular round dilatation and "ladders"- diffuse widening of the intercellular space. Immunohisto-chemistry offers another possibility of visualization of DIS with anti-desmoglein antibody to mark intercellular compartments of the epithelium. Manual evaluation of the DIS degree is subjective and inaccurate. Our aim was to design an automated image analysis method for morphometric study of DIS, which is based on immunohistochemical (ihc) staining. Microscopic slides were prepared using desmoglein-3, to stain esophageal tissue. For automatic "ladders" detection we design context based method, which is based on structural mask that represents line structures. Mask is divided in two areas- foreground, which should contain line structures and background, where we should not find them. Line structures are perceived as collection of pixels with high values, which are set in common direction. Localization of line structures is done by evaluating collection of pixels in respect of given areas. DIS that creates "ladders" pattern is stained brown. We use color deconvolution to create input image that represents intensity of ihc reaction and then we apply designed line structure filter. Our proposed method is able to localize 80% to 90% of "ladders" structure, which were marked by expert. The recognized intercellular regions preserve the distance between the cells membranes with desmosomes. Thus, the quantitative evaluation of DIS is possible. Also, based on the segmentation of recognized intracellular regions into the segments an each cell is characterized and examined. Future work will cover problems of DIS structure scoring.

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References

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