CORRELATION BETWEEN MORPHOMETRIC PARAMETERS OF THE COLON AND THE DEGREE OF HYPOXIA

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Abstract: *This study evaluates the correlation between morphometric parameters of the colon and the degree of hypoxia. Particular attention was paid to the thickness of the mucosa, crypt depth, epithelial height, goblet cell density, submucosal thickness, muscular layer thickness, and the state of the microcirculatory bed. The severity of hypoxia was assessed using indirect morphological and microvascular criteria. Correlation analysis demonstrated a strong negative relationship between hypoxia intensity and epithelial height, crypt depth, and goblet cell number, while a positive correlation was observed with submucosal edema and vascular congestion. Progressive hypoxia led to structural remodeling of all layers of the colonic wall and impairment of its functional activity. The findings confirm that morphometric indicators of the colon can serve as objective markers for assessing tissue hypoxia.*

Keywords: *colon, morphometry, hypoxia, crypt depth, epithelial height, goblet cells, microcirculation, correlation analysis.*

Main part

Introduction

Hypoxia is one of the leading pathogenetic factors in many pathological conditions and is accompanied by metabolic disturbances, microcirculatory disorders, and structural tissue damage. The colon is highly sensitive to oxygen

deficiency due to the high proliferative activity of its epithelium and the intensity of absorptive and secretory processes.

Morphometric analysis allows quantitative assessment of structural changes and provides objective criteria for evaluating the functional state of tissues. Establishing a correlation between morphometric parameters and the degree of hypoxia is important for understanding the mechanisms of tissue injury and for developing diagnostic markers.

However, data on the quantitative relationship between hypoxia severity and structural remodeling of the colon remain limited, which determines the relevance of the present study.

Materials and methods

The study was carried out on experimental laboratory animals exposed to conditions leading to different degrees of hypoxia.

Colon tissue samples were fixed in neutral buffered formalin, embedded in paraffin, and stained with hematoxylin and eosin.

The following morphometric parameters were measured:

- thickness of the mucosal layer;
- crypt depth;
- epithelial cell height;
- goblet cell density;
- thickness of the submucosa;
- thickness of the circular and longitudinal muscular layers;
- diameter and blood filling of microvessels.

The degree of hypoxia was assessed based on:

- microcirculatory disturbances;
- severity of stromal edema;
- dystrophic cellular changes.

Correlation analysis was performed using Pearson's correlation coefficient, with statistical significance set at $p < 0.05$.

Results and discussion

The analysis revealed a significant relationship between the severity of hypoxia and morphometric parameters of the colon.

A strong negative correlation was found between the degree of hypoxia and:

- epithelial height;
- crypt depth;
- goblet cell density.

These changes indicate suppression of proliferative activity and decreased secretory function of the mucosa.

A positive correlation was observed between hypoxia severity and:

- submucosal thickness;
- vascular lumen dilation;
- interstitial edema.

These features reflect increased vascular permeability, venous congestion, and impaired tissue trophism.

The thickness of the muscular layer showed a moderate negative correlation with hypoxia, which may be associated with dystrophic changes in smooth muscle cells and decreased motor function.

Pathogenetic interpretation

Under hypoxic conditions:

- oxidative phosphorylation is inhibited;
- ATP synthesis decreases;
- ion transport is impaired;
- cellular swelling develops.

Microcirculatory disorders further aggravate oxygen deficiency, forming a vicious circle that leads to progressive structural damage.

Reduction in goblet cell number weakens the mucosal barrier, while shortening of crypts indicates inhibition of epithelial regeneration.

Functional significance

The established correlations demonstrate that morphometric parameters of the colon reflect the severity of hypoxic injury and can be used as objective criteria for assessing tissue oxygen deficiency.

Conclusion

A significant correlation exists between the morphometric parameters of the colon and the degree of hypoxia. Increasing hypoxia is associated with a decrease in epithelial height, crypt depth, goblet cell density, and muscular layer thickness, as well as with an increase in submucosal edema and vascular congestion.

Morphometric analysis can serve as an informative and objective method for assessing hypoxic tissue damage and functional impairment of the colon.

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