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Assessment of the Efficiency of the Narrow-Band Imaging With Optical Magnification in the Diagnostics of Upper Gastrointestinal Diseases

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Summary *— The article is devoted to the study of the capabilities of the EG-2990Zi video gastroscope combined with the EPK-i7000 Pentax video processor in the process of comparative assessment of the effectiveness of using narrow-band video imaging with optical magnification in diagnosing certain diseases of upper gastrointestinal, namely, the esophagus, gaster, and duodenum. In particular, the method of comparative assessment of the mucous coat condition and morphological criteria in patients with Barrett's esophagus, as one of the serious complications of gastroesophageal reflux disease, is considered when performing narrow-band video imaging with optical magnification compared to a routine endoscopic examination technique. At the second stage, endoscopic indices and morphological diagnostic criteria in patients with ulcers and cicatricial deformity of the gaster and duodenum were compared. The final stage is connected with the study of the state of the mucous coat and morphological criteria in patients with polyps of the stomach and duodenum.*

The result of a comparative analysis of the findings obtained using these methods enables the early detection of changes in the mucous coat of the esophagus, preceding neoplastic ones when coinciding with the morphological conclusion in patients with the above diseases. The main points of scientific novelty include the following: a clear diagnostic algorithm has been first proposed for diseases of upper gastrointestinal diseases, taking into account the use of innovative technologies combined with a morphological study of biopsy material, which differs from routine endoscopic examination only in white light using a logical structure of study of the effectiveness of various endoscopic imaging visualization modes in terms of detailing of the micrograph and angioarchitecture of the mucous coat during the identification of spread and extent of manifestation of various chronic pathologies of the esophagus, gaster and duodenum; it has been proposed to assess the inter-relation between the data of endoscopic examinations and morphological criteria within the independent main and control groups, differing in the use of correlation analysis by the Spearman criterion and allowing to statistically substantiate the advantages of narrow-band imaging with high resolution in matters of early detection of changes in the mucous coat of the esophagus, gaster, duodenum, preceding neoplastic ones.

Keywords: narrow-band video imaging, morphological criteria, endoscopic parameters, condition of the mucous coat, diagnosis

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I. INTRODUCTION

Currently, the topic of pretumor diseases of the organs of upper gastrointestinal diseases remains one of the leading ones in the field of modern gastroenterology, which stipulated the need to look for new and improve conventional diagnostic methods. Technical progress provides opportunities for the enhancement of medical equipment and the creation of innovative clinical and diagnostic systems that improve the detection of lesions of the esophageal and gastric mucous coat. The introduction of the new and significant improvement in the known approaches and tactics of patient management becomes inevitable, as well as identification of the limits of applicability of new diagnostic methods at the present stage of development of evidence-based medicine in order to increase the coincidence of endoscopic and morphological diagnoses [1].

Conducting comprehensive clinical and diagnostic examinations focused on the detection, classification and study of the characteristics of the abnormal focus are the most important steps of the diagnostic algorithm in modern standard endoscopy, the purpose of which is to study and analyze the relationship between the clinical picture, visual and morphological assessment of the mucous coat of the upper gastrointestinal to provide an opportunity to assess the dynamics of development of microstructural transformations [2]. In this regard, due to the use of high-resolution HD + gastrointestinal endoscopy, integrated with i-scan technology with optical zoom functionality, which implies post-processing of reflected light,

there are prospects for a more thorough assessment of the mucous coat of the organs under study and it has become more reasonable to use the algorithm of logical choice of clinical diagnostic measures with upper gastrointestinal pathologies. Previously, a chromoendoscopy method was used to identify metaplastic
epithelium, in which the metaplastic epithelium was subjected to staining with methylene blue, toluidine blue, indigo carmine, while multilayer flat epithelium was stained with Lugol's solution. However, despite the fact that this method is rather laborious and time-consuming, at present, thanks to the use of virtual chromoendoscopy, image clarity is improved and it has also become possible to implement the determination of the surface structure of the tissue, the prevalence of the abnormal focus, to assess the architectonics of the vascular network in the affected area [3].

Timely endoscopic visualization of changes in the mucous coat of the gastrointestinal organs preceding malignant ones is also one of the priority areas of medicine at the present time. This problem cannot be solved without the use of innovative technologies in endoscopic practice.

The objective of this study is to increase the effectiveness of endoscopic diagnostics aimed at patients with Barrett's esophagus, with an ulcer and cicatricial deformity of the gaster and duodenum, as well as patients with gastric and duodenal polyps using high-resolution narrow-band imaging and comparing its results with morphological examinations findings using mathematical statistics methods.

II. MATERIALS AND METHODS

As a result of the research conducted, the results of endoscopic diagnostics were analyzed along with the assessment of the morphological parameters of two groups of patients: the main examination, which was conducted using narrow-band imaging with HD resolution + i – scan with optical magnification (MagniView function) and control examination, where the examinations were conducted according to the standard method. The patient distribution by groups depending on the types of nosology studied is presented in Table 1. In the course of work in the main group, a video gastroscope with a magnification of EG-2990Zi and MagniView technology was used in the examination, providing 136 times image magnification for super-precise and detailed mucosal images, which plays an important role in the diagnosis of early stages of pathologies of the gaster and esophagus.

Table 1.

No.	Diseases	Main group		Control group	
		abs.	%	abs.	%
1.	Barrett's esophagus	48	28.402	21	18.421
2.	Ulcer and cicatricial deformity of the gaster and duodenum	70	41.420	50	43.860
3.	Polyps of the gaster and duodenum	51	30.178	43	37.719
Total		169	100	114	100

At the same time, the question of the quality of the visualization of the lesion with a pathologically changed mucosa is of particular importance for the endoscopist.

The use of statistical methods for the purpose of scientific substantiation of the advantages of one or another method of endoscopic diagnosis when comparing its results with the data of morphological examinations is intended to increase the efficiency of diagnosis of upper gastrointestinal diseases.

In accordance with this thesis, it seems appropriate to implement the following steps related to the analysis of the effectiveness of endoscopic examination techniques:

1. To carry out a study of the frequency characteristics of endoscopic examination parameters and morphological parameters of diagnostics among patients in both the main and control groups with an assessment of the sensitivity of patient characteristics to the type of examination method using nonparametric $\chi 2$ - Pearson criterion [4].
2. To propose a method of numerical reduction and rationing of quality indicators based on a priori ranking methods and the representation of linguistic terms in the framework of fuzzy assessment procedure [5]
3. On the basis of the non-parametric Mann-Whitney test, to test the hypothesis of belonging to a homogeneous general population of patient characteristics of the main and control groups.
4. To numerically evaluate the relationship between endoscopic parameters and morphological characteristics of patients within the main and control groups based on the Spearman's rank correlation criterion and to make reasonable conclusions about the advantages of a certain diagnostic technology.
5. To make informed conclusions about the benefits of a particular diagnostic technology.

The calculations were carried out using the following software: preparation, structuring and filtering of data, as well as calculations of numerical and normalized values, presented in section 2.2.1 were carried out in Microsoft® Office Excel®2007; calculations in accordance with static methods in the Statistica10. Copyright © StatSoft, Inc. program.

III. DISCUSSION AND RESULTS

3.1. Assessment of endoscopic presentation of the condition of the mucous coat and morphological criteria in patients with Barrett's esophagus.

Barrett's esophagus is a background premalignancy and is the replacement of the stratified squamous non-squaring epithelium of the esophagus with a cylindrical epithelium, often with symptoms of intestinal metaplasia. According to modern concepts, it is intestinal metaplasia that has neoplastic potential.

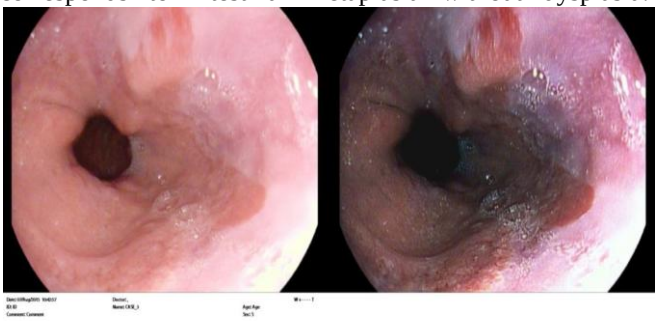
In the structure of oncological morbidity of the population of the Russian Federation, esophageal cancer occupies the 13th place among men and 19th among women. The detection of this pathology at routine check-ups remains extremely low and does not exceed 2%, the prognosis is poor - five-year survivability for esophageal cancer is only 10% and does not depend on the histological type of the tumor and the degree of its differentiation.

Thus, the aggressive course of esophageal tumors, poor treatment outcomes and the low level of five-year survivability associated with late diagnosis, prompt the search for new ways to prevent the development of the tumor process, earlier endoscopic diagnosis of pre-tumor restructuring of the esophageal mucosa [6].

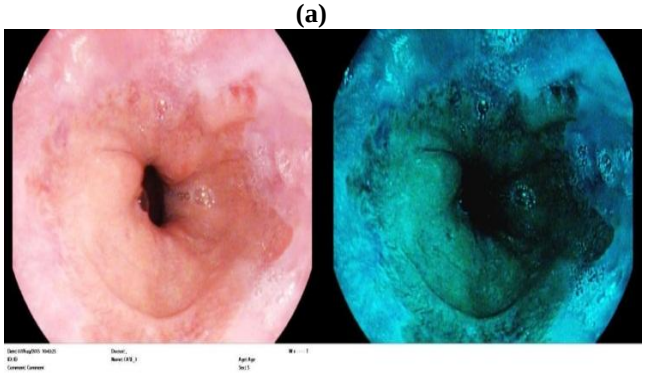
The endoscopic method is leading in the diagnosis of Barrett's esophagus and is based on identifying key anatomical landmarks of the distal esophagus and cardiac orifice - the area of the esophagogastric junction, the proximal edge of the folds of the mucous coat of the gaster, the longitudinal vessels of the mucous coat, the Z-line, and on the measurement of the length of a segment of Barrett esophagus of the distal esophagus during a morphological study [7]. In experienced endoscopic physicians, endoscopic and morphological diagnoses of the disease coincide in 80-90% of cases [7].

The Prague classification of metaplasia in the esophagus (2004) was used to describe the pathological segments of Barrett's esophagus, which takes into account two features: the length of the circular segment of the metaplastic epithelium (C); the total length (maximum) of metaplastic epithelium (M), starting from the upper sections of the gastric folds. In Figure 1. an endoscopic picture of the patient's mucosa with Barrett's esophagus is shown when viewed in Pit-pattern white light- HD + high-resolution image.

In Figure 1 (a), on the background of the pink mucosa, segments with bright mucosa C (1.5), M (2.5) are identified. As can be seen from Figure 1 (b), the pathological segments are visualized in a violet-blue glow with clear contours against the background of the emerald shade of the esophageal mucosa, with a detailed examination visible dilated vessels at the base of the circular segment with a blue glow. Figure 1 (c) shows the type I IPCL. An ordered pectiniform microstructure attracts attention, which corresponds to intestinal metaplasia without dysplasia.



(a)



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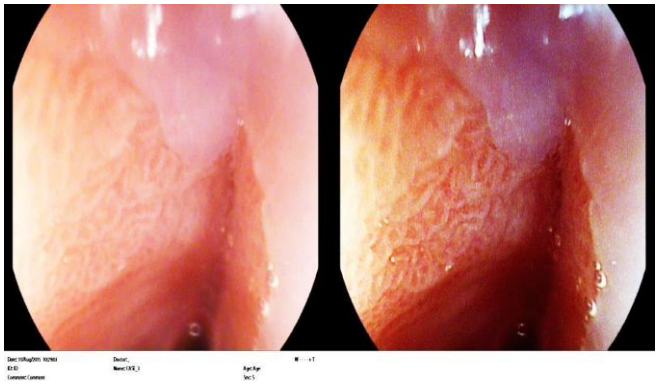
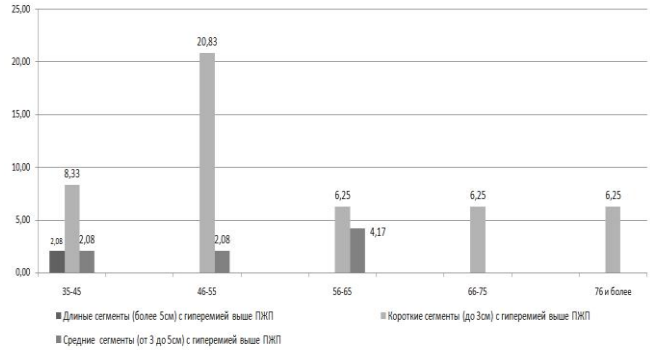


(c)

Fig.1. Endoscopic picture of Barett's esophagus in white light
a) Inspection in Pit-pattern white light. High-resolution HD + image (left) and an image with the i-scan SE (SurfaceEnhancement) function.
b) Pit-pattern white light high-resolution HD examination + image and an image using the TE scan function.
c)Pit-pattern white light high-resolution HD examination + image and image magnification feature

As an example of the graphical interpretation of the data in the table, Fig. 2 presents a frequency comparison (in percent) of the studied men depending on the age and classification options of the Barett's esophagus when viewed in Pit-pattern white light in the main and control groups.



Длинные сегменты (более 5 см) с гиперемией выше ПЖП	Long segments (more than 5 cm) with hyperemia higher than esophagogastric junction
Средние сегменты (от 3 до 5 см) с гиперемией выше ПЖП	Medium segments (3 to 5 cm) with hyperemia higher than esophagogastric junction
Короткие сегменты (до 3 см) с гиперемией выше ПЖП	Short segments (up to 5 cm) with hyperemia higher than esophagogastric junction

Fig. 2. Frequency comparison (in percent) of the studied men depending on the age and size of the area of the esophagogastric junction in the main and control groups

The study involved 22 (45.83%) men and 26 (54.17%) women in the main group and 10 (47.61%) men and 11 (52.38%) women in the control group. Patients of the main

group were distributed by age as follows: up to 25 years old - no patients with the studied disease were identified; 26-35 years old - 2 (4.17%) people; 36-45 years old - 6 (12.50%) people; 46-55 years old - 10 (20.83%) people; 56-65 years old - 11 (22.92%) people; 66-65 years old - 14 (29.17%) people and 76 years old and more - 5 (10.42%) people. In the control group, the following distribution of patients by age was noted: up to 25 years - 1 (4.76%) people; 26-35 years old - 1 (4.76%) people; 36-45 years old - 2 (9.52%) people; 46-55 years old - 3 (14.29%) people; 56-65 years old - 7 (33.33%) people; 66-65 years old - 5 (23.81%) people and 76 years old and more - 2 (9.52%) people. During the Pit-pattern white light examination the patients of the main group were divided the following way according to the size of the area of the esophagogastric junction: long segments (more than 5 cm) with hyperemia higher than esophagogastric junction - 2 (4.17%) people, short segments (up to 3 cm) with hyperemia higher than esophagogastric junction - 41 (85.42%) people, medium segments (3 to 5 cm) with hyperemia higher than esophagogastric junction - 5 (10.42%) people. The distribution by the size of the esophagogastric junction, when viewed in Pit-pattern white light in the control group, was as follows: long segments (more than 5 cm) with hyperemia higher than esophagogastric junction - 3 (14.29%) people, short segments (up to 3 cm) with hyperemia higher than esophagogastric junction - 14 (66.67%) people, medium segments (3 to 5 cm) with hyperemia higher than esophagogastric junction - 4 (19.05%) people. This percentage distribution is made relative to the total number of patients within each group.

As can be seen from Fig. 2, among men in the 46–55 age group, the predominant Pit-pattern white light examination criteria were marked by short segments (up to 3 cm) with hyperemia higher than esophagogastric junction.

Similar frequency comparisons were made for all indicators of the main and control groups. In accordance with the first task, the remaining patient parameters were analyzed: deformation of the mucous coat microstructure, subepithelial architectonics, gastric metaplasia, intestinal metaplasia, Helicobacter Pilory, atrophy, dysplasia, and cellular sclerosis.

Formally, the second task consists in determining the independence of two considered features, for example, X (gender) and Y (examination method) or testing the null hypothesis H0: the research method (traditional and endoscopic examination in a narrow spectrum with optical zoom) does not depend on gender effectively regardless of on the patient's gender), with the alternative hypothesis H1: the examination method depends on the gender (the patient's gender affects the effectiveness of the examination).

H_0 hypothesis is accepted at the level of significance α, if $\chi_в^2 < \chi_{1-\alpha}^2(1)$, where $\chi_{1-\alpha}^2(1)$ – quantile of chi-square distribution with one degree of freedom of order 1 - α.

For this example, the sample value $\chi_в^2$ = 1,43, and with the Yates Amendment — $\chi_в^2$=1,20. Since $\chi_{0,95}^2$ =3,84 and $\chi_в^2$< 3,84, then the H_0 hypothesis is accepted at the level of significance: α = 0,05 it should be considered that the effectiveness of both narrow-band optical zoom and traditional, routine endoscopy does not depend on gender.

The third task is formulated based on the assumption that for statistical processing using modeling all data must be represented in a numerical form. Given that the personal data were presented both in quantitative and qualitative form, we considered it appropriate to convert information containing fixed semantic (linguistic) values to numerical form [5].

The conversion is as follows. At the first stage, for each indicator, all its possible values are ranked by degree of significance. For the ranking of each value, an a priori ranking method is used, which uses expert information and does not require, in contrast to analysis of variance, to set up an experiment on the object [4]. The a priori ranking method allows an objective assessment of the subjective opinion of specialists (experts), since, with a large number of factors, expert opinion on the degree of influence of a particular factor may differ.

When collecting a priori information, experts (m> 7) are asked to fill in questionnaires in which n values of the indicator should be assessed depending on the degree of their influence on the incidence of pelvic inflammatory diseases.

As a result of ranking indicators by the degree of decreasing or increasing their influence, a certain rank is assigned to each linguistic value. If experts find it difficult to assign different ranks to all values, they can assign the same ranks to two or more variables. In the case of matched ranks, the ranking matrix is normalized so that the sum of the ranks in each row of the ranking matrix, where the conclusion of the j-th researcher is written down, ($j=\overline{1,m}$), equaled $n(n+1)/2$. For this, variables with the same ranks are assigned a rank equal to the average value of the places that the variables have divided among themselves.

According to the ranking matrix, the consistency of experts is assessed using the concordance coefficient. The obtained ranks can be used as a numerical estimate of the indicator values.

To illustrate the above, we give an example of determining a numerical score for an indicator characterizing NR. This indicator can take 4 different values: "absent", "weak degree", "moderate degree", "pronounced degree". The evaluation was made by a 4-point scale. Based on the aggregate opinions of experts, a matrix of weighting coefficients was compiled (Table 2).

TABLE 2
The matrix of the ranking values of the "NR Level" indicator

Indicator value	Marks by 8 experts							
	1	2	3	4	5	6	7	8
1. Absent	4	3	3	4	4	2	4	4
2. Weak degree	2	2	3	2	2	2	3	2
3. Moderate degree	3	2	2	3	3	2	2	3
4. Pronounced degree	1	1	1	1	1	1	1	1

Since the same expert assigned the same weight to some values of the indicator, the ranking matrix had to be brought to normal appearance (Table 3), so that the sum of the ranks in each column was K* (K+1)/2, where K is the number of different values of the indicator “NR level” (K=4).

Table 3
The reduced matrix of the ranking values of the "NR Level" indicator

Indicator value	Marks by 8 experts								Ranking sum
	1	2	3	4	5	6	7	8	
1. Absent	4	4	3.5	4	4	3	4	4	30.5
2. Weak degree	2	2.5	3.5	2	2	3	3	2	20.0
3. Moderate degree	3	2.5	2	3	3	3	2	3	21.5
4. Pronounced degree	1	1	1	1	1	1	1	1	8.0

The result of the calculation the value of the coefficient of coordination was obtained $W = 0{,}7634$, $\chi^2_{est} = 18{,}3214$.

Since the calculated value was more critical when the number of degrees of freedom $\nu = n-1 = 3$ and level of significance q = 5% ($\chi^2_{table} = 7{,}815$), then the hypothesis of consistency of experts was accepted. Thus, the following ordered sequence of values of the "NR" indicator was obtained: “absent”, “weak degree”, “moderate degree”, “pronounced degree”. To determine the numerical evaluation of each indicator value, a pair-wise comparison of the linguistic values of indicators was made based on expert assessments. The results are shown in Table 4.

Table 4
Results of sorted linguistic values comparison of the "NR level" Indicator

Numbers of compared values	Marks by 8 experts								Average value
	1	2	3	4	5	6	7	8	
1-2	4	2	2	3	4	2	3	3	2.845
2-3	3	2	2	3	2	2	1	2	2.125
3-4	4	2	3	3	4	2	3	4	3.125

As a result of calculations, numerical estimates were obtained for each linguistic value of the “NR level” indicator (Table 5).

Similar calculations were performed for all indicators that do not have a numerical estimate. Thus obtained normalized indicators characterizing risk factors were used in applying the methods of mathematical statistics.

Since all the indicators reduced to the numerical estimate, were measured in different scales, it is advisable to carry out the normalization of indicators by the formula

$$X_i = \frac{x_i - x_{imin}}{x_{imax} - x_{imin}}$$

where x_i – current indicator value; x_{imin}– the minimum value of the indicator among all gradations; x_{imax} – the maximum value of the indicator among all gradations.

Table 5
Numerical estimates of the values of the "NR level" indicator

Linguistic indicator value	Numerical estimate of the value	Normalized estimate
1. Absent	0	0
2. Weak degree	2.845	0.3502
3. Moderate degree	5.000	0.6154
4. Pronounced degree	8.125	1.0000

The fourth task, assessing the degree of correlation, is related to the fact that rank correlation coefficients (like most non-parametric estimates) are less sensitive to emissions and errors in the results of observations and, in this sense, are more stable and reliable measures of interdependence compared to the Pearson correlation coefficient [4].

After calculating all the Spearman's rank correlation coefficients, they were ranked in absolute terms.

The results of ranking the rank correlation coefficients between the indicators of the main group are presented in tables 6 and 7.

Table 6
The relationship of endoscopic diagnostic indicators with Barrett's esophagus (main group)

	Name of the indicator	Pit-pattern-white light examination		Deformation of the microstructure of the mucous coat	
		r	Rank	r	Rank
1	Gastric metaplasia	-0.33481	5	-0.486172	4
2	Gender	-0.20433	6	-0.261785	5
3	Age	-0.16521	7	-0.109633	6
4	Intestinal metaplasia	0.45592	4	0.653753	3
5	Dysplasia	0.53076	3	0.762932	2
6	Deformation of the microstructure of the mucous coat	0.77019	2	1.0000	
7	of subepithelial angioarchitecture	0.77019	1	-	-
8	Pit-pattern- white light examination	1.0000		0.770193	1

Table 7
The relationship of morphological criteria for diagnostics of Barrett's esophagus (main group)

	Name of the indicator	Intestinal metaplasia		Dysplasia	
		r	Rank	r	Rank
1	Gastric metaplasia	-0.88814	1	-0.574513	4
2	Gender	-0.21288	6	-0.244379	6
3	Age	-0.20882	7	-0.20220	7
4	Pit-pattern- white light examination	0.45592	5	0.530763	5
5	Deformation of the microstructure of the mucous coat	0.65375	4	0.762932	3
6	Subepithelial angioarchitecture	0.65375	3	0.762932	2
7	Dysplasia	0.79051	2	1.0000	
8	Intestinal metaplasia	1.0000		0.790513	1

In conclusion, according to the fifth problem, the formulation of which is stated above, we can draw the following conclusions:

- Frequency comparative analysis of the main and control groups revealed the characteristics of the qualitative composition of the studied patients for the totality of both endoscopic and morphological parameters;

- due to the method of bringing qualitative estimated to quantitative ones based on the use of expert methods and the use of the non-parametric statistical Mann-Whitney criterion, the hypothesis H0 about belonging to the homogeneous population of patient characteristics of the main and control groups has been rejected. Differences in patient groups in all indicators were reliably confirmed;

The data obtained indicate high diagnostic efficiency of innovative technology in identifying changes in the mucous coat of the esophagus, with neoplastic potential.

3.2. Assessment of the endoscopic presentation of the condition of the mucous coat and morphological criteria in patients with ulcer and cicatricial deformity of the gaster and duodenum.

A peptic ulcer is one of the most common diseases among the working-age population and accounts for about 20-30% of all gastrointestinal diseases [1, 2], which, in turn, rank third in the world's prevalence after cardiovascular diseases and cancer pathology [9].

The main diagnostic criterion for peptic ulcer disease is the presence of structural and functional changes in the gastric mucosa, as in some cases the metaplastic epithelium undergoes dysplastic changes and then neoplastic processes. Therefore, complex clinical and endoscopic studies are carried out, the purpose of which is to study and analyze the relationship between the clinical picture, visual and morphological assessment of the state of the mucous coat of the examined organs in order to predict the development of structural disorders [3]. A number of authors note that changes in the visual representation during chromoendoscopy contribute to the early detection of structural changes in the mucous coat of the examined organs.

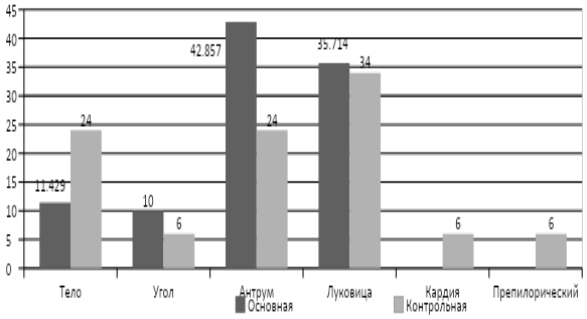
Based on the formulation of the first task, as an example, Table 3 presents the results of cross-queries on a database corresponding to the main group, in which pathology localization frequencies are analyzed during the Pit-pattern white light examination depending on the gender and age groups of patients.

Similar frequency comparisons were made for all indicators of the main and control groups. In accordance with the first task, the remaining indicators of the patients were analyzed when viewed in white light, namely: chronization/degree of scar deformity of the duodenal bulb, ulcer size, defect filling (fibrin/hematin). Also, such indicators as examination in the i – scan SE and TE modes with the use of violet and blue glow were considered. MagniView mode (magnification of 136 times) estimated deformity of the mucous coat microstructure and subepithelial architectonics. These indicators were evaluated only in the main group.

Table 8.
The distribution of patients by localization of the pathological process in the main group depending on gender and age group & Results

Gender	Age	Localization							
		Antrum		Duodenal cap		Body		Angle	
		Quantity	%	Quantity		Quantity	%	Quantity	%
Man	Up to 25	0.00	0.00	5.00	7.14	0.00	0.00	1.00	1.43
Woman		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Man	26-35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Woman		4.00	5.71	2.00	2.86	0.00	0.00	0.00	0.00
Man	36-45	0.00	0.00	2.00	2.86	0.00	0.00	0.00	0.00
Woman		3.00	4.29	4.00	5.71	0.00	0.00	0.00	0.00
Man	46-55	2.00	2.86	3.00	4.29	1.00	1.43	0.00	0.00
Woman		3.00	4.29	1.00	1.43	0.00	0.00	2.00	2.86
Man	56-65	2.00	2.86	0.00	0.00	4.00	5.71	0.00	0.00
Woman		6.00	8.57	3.00	4.29	1.00	1.43	2.00	2.86
Man	66-75	1.00	1.43	2.00	2.86	1.00	1.43	1.00	1.43
Woman		5.00	7.14	0.00	0.00	0.00	0.00	1.00	1.43
Man	76 and over	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Woman		3.00	4.29	3.00	4.29	1.00	1.43	1.00	1.43
Total		29.00	41.43	25.00	35.71	8.00	11.43	8.00	11.43

The remaining indicators were quantified in two groups, namely: identified pathology, gastric metaplasia, intestinal metaplasia, HelicobacterPilory, atrophy, dysplasia, and net sclerosis. An example of a comparison of the studied groups depending on the frequency of intestinal metaplasia in% is shown in Figure. 3



Тело	Body
Угол	Angle
Антрум	Antrum
Луковица	Duodenal cap
Кардия	Cardiac orifice
Препилорический	Prepyloric
Основная	Main
Контрольная	Control

Fig.3. Comparison of the frequency (%) of the examined in the main and control groups depending on localization when examined in Pit-pattern white light

As a result of the comparison presented in Fig. 4 using the criterion χ^2 it was concluded that the differences between the main and control groups by the parameter "Inspection in white light: localization" are significant, since at a significance level p=0,000357<0,05 the value of the calculated criterion is $\chi^2_в = 43.43$.

The results of ranking the rank correlation coefficients between the indicators of the main group are presented in tables 9 and 10.

Table 9

The relationship of endoscopic diagnostic indicators of gastric mucosa with gastric ulcer and duodenal ulcer

	Name of the indicator	i-scan SE and TE mode examination		Deformation of the microstructure of the mucous coat	
		r	Rank	r	Rank
1	NR	-0.11275	8	-0.22354	6
2	Localization	-0.37337	5	-0.38648	5
3	Age	-0.33927	4	-0.34337	4
4	Revealed pathology	-0.07186	9	-0.06067	9
5	Gender	-0.07073	10	0.00770	10
6	Intestinal metaplasia	0.17650	7	0.23421	7
7	Cellular sclerosis	0.22743	6	0.15649	8
8	Dysplasia	0.37704	3	0.446482	3
9	Atrophy	0.37798	2	0.494594	2
10	Deformation of the microstructure of the mucous coat	0.84446	1	1.0000	
11	i-scan SE and TE mode examination	1.0000		0.844461	1

Table 10

The relationship of indicators of the morphological state of the gastric mucosa with gastric ulcer and duodenal ulcer

	Name of the indicator	Atrophy		Dysplasia	
		r	Rank	r	Rank
1	Age	-0.41800	2	-0.114264	6
2	Localization	-0.27961	5	-0.247488	4
3	Size	-0.25759	7	-	
4	NR	-0.18056	8	-0.099810	7
5	Revealed pathology	-0.02927	12	-0.027092	10
6	Defect filling	-0.02722	13	-	
7	Gender	0.04258	11	-0.056777	8
8	Intestinal metaplasia	0.15793	10	-0.047534	9
9	Chronization/degree of scar deformity of the duodenal bulb	0.17370	9	-	
10	Cellular sclerosis	0.27913	6	0.228665	5
11	Dysplasia	0.30043	4	1.0000	
12	i-scan SE and TE mode examination	0.37798	3	0.377037	2
13	Deformation of the microstructure of the mucous coat	0.49459	1	0.446482	1
14	Atrophy	1.0000		0.300428	3

At the same time, the results of ranking the rank correlation coefficients between the indicators of the control group are presented in Table 11. This table represents the screenshots of the results of the module of nonparametric statistics when calculating the Spearman correlation coefficients in the Statistica 10. Copyright © StatSoft, Inc. program.

Table 11

The relationship of endoscopic studies and the morphological state of the gastric mucosa with gastritis (control group)

Spearman Rank Order Correlations (Spreadsheet1)
MD pairwise deleted
Marked correlations are significant at p <,05000

Variable	Пол	Возраст	Выявленная патология	Локализация	Хронизация	Размер	Заполнение дефекта	HP	Атрофия	Желудочная метаплазия	Кишечная метаплазия	Дисплазия	Сетчатый склероз
Пол	1,000000	0,068969	0,001471	-0,190366	0,100137	0,091854	0,208046	0,123921	0,308623	0,275487	0,015058	0,334077	0,159822
Возраст	0,068969	1,000000	0,077424	-0,197440	-0,074147	0,421879	-0,091512	-0,161976	-0,002836	-0,245539	-0,283529	-0,124067	-0,025294
Выявленная патология	0,001471	0,077424	1,000000	0,381055	0,015232	-0,128392	-0,112896	-0,044109	0,034604	0,272383	-0,171222	-0,024773	-0,191989
Локализация	-0,190366	-0,197440	0,381055	1,000000	-0,079109	0,111097	-0,000338	0,045238	-0,071658	0,248182	-0,062743	0,040129	-0,204534
Хронизация	0,100137	-0,074147	0,015232	-0,079109	1,000000	-0,122262	-0,019404	0,299809	0,214102	0,285201	0,173433	-0,008646	0,471632
Размер	0,091854	0,421879	-0,128392	0,111097	-0,122262	1,000000	-0,102073	-0,086753	-0,022445	-0,242923	-0,066392	-0,139929	-0,003951
Заполнение дефекта	0,208046	-0,091512	-0,112896	-0,000338	-0,019404	-0,102073	1,000000	0,013369	0,132244	0,346982	0,146990	0,662725	0,173080
HP	0,123921	-0,161976	-0,044109	0,045238	0,299809	-0,086753	0,013369	1,000000	0,054719	0,249359	0,149933	-0,166316	0,289328
Атрофия	0,308623	-0,002836	0,034604	-0,071658	0,214102	-0,022445	0,132244	0,054719	1,000000	0,589015	0,535264	0,267857	0,341714
Желудочная метаплазия	0,275487	-0,245539	0,272383	0,248182	0,285201	-0,242923	0,346982	0,249359	0,589015	1,000000	0,348466	0,515388	0,276517
Кишечная метаплазия	0,015058	-0,283529	-0,171222	-0,062743	0,173433	-0,066392	0,146990	0,149933	0,535264	0,348466	1,000000	0,084515	0,194603
Дисплазия	0,334077	-0,124067	-0,024773	0,040129	-0,008646	-0,139929	0,662725	-0,166316	0,267857	0,515388	0,084515	1,000000	-0,041916
Сетчатый склероз	0,159822	-0,025294	-0,191989	-0,204534	0,471632	-0,003951	0,173080	0,289328	0,341714	0,276517	0,194603	-0,041916	1,000000

Gender	**Gender**
Age	**Age**
Revealed pathology	**Revealed pathology**
Localization	**Localization**
Chronization	**Chronization**
Size	**Size**
Defect filling	**Defect filling**
NR	**NR**
Atrophy	**Atrophy**
Gastric metaplasia	**Gastric metaplasia**
Intestinal metaplasia	**Intestinal metaplasia**
Dysplasia	**Dysplasia**
Cellular sclerosis	**Cellular sclerosis**

In conclusion, according to the fifth problem, the formulation of which is set forth above, we can draw the following conclusion, which differs from the conclusion based on the comparison of studies in the main and control groups on Barrett's esophagus, namely: comparing Eables 10 - 11 you can see that the number of significant Spearman's rank correlation coefficients in the control group is significantly less than in the main group, which allows concluding that the endoscopic and morphological diagnosis of the disease is the best match when applying the narrow-band imaging with optical zoom.

The findings also indicate high diagnostic efficiency of innovative technology in identifying changes in the gastric mucosa with neoplastic potential.

3.3. Assessment of endoscopic presentation of the state of the mucous coat and morphological criteria in patients with gastric and duodenal polyps.

Polypus is called any limited lump, protruding into the lumen of the organ [1]. They are benign epithelial tumors of the gaster. The detection rate of polyps by the autopsy materials is 3% in relation to all gaster tumors, while during endoscopic examination, according to various authors, they are detected in 0.6% - 8.7% of cases [10].

The frequency of malignancy of polyps varies in wide ranges from 2.6 to 60% [11]. It should be remembered that the diagnostic capabilities of the morphologist in detecting a tumor in the study of endoscopic material have limitations associated with the small size of the piece, and in this connection, the accuracy of taking biopsy material becomes especially important, which is facilitated by the use of optical zoom technology.

The fact of detecting the deformation of the microstructure of the tissue with the deformation of the vascular pattern when examining a seemingly ordinary gastric polyp using an innovative technique, while as a result of a histological study of biopsy, carcinoid was detected (Fig. 4) convincingly proves this statement.

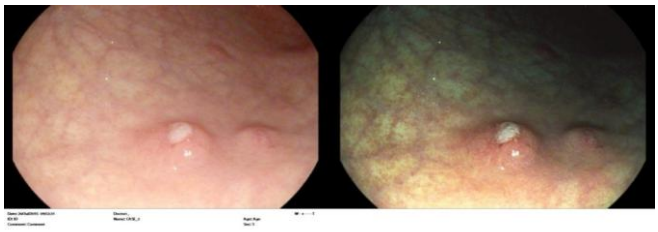


Fig. 4. Endoscopic representation of the gastric mucosa in a patient with eroded gastric polyps

Fig. 4 presents the mode of simultaneous display of two TwinMode images: a Pit-pattern- white light examination high-resolution HD + image and an image using the i-scanSE function (SurfaceEnhancement).

Fig. 5 shows a Pit-pattern- white light examination high-resolution HD + image and magnification by 136 times (Pentax MagniView optical zoom technology).

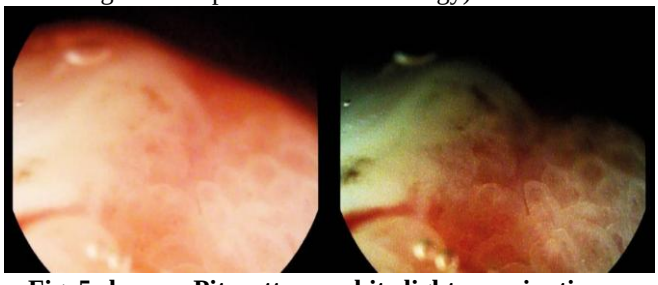


Fig. 5 shows a Pit-pattern- white light examination high-resolution HD + image and magnification by 136 times (Pentax MagniView optical zoom technology).

The reticular microstructure of the mucous coat is hyperplastic, acquiring the form of finger-like outgrowths with a regular vascular pattern, closer to the center of the polypoid formation there is a deformation, a break in the reticular structure, blurring of the vascular pattern.

Pit-Pattern white light examination allowed differentiating the following localization groups of the pathological process: - in the main group - body - 11 (21.56%) people; antrum - 32 (62.74%) people; duodenum - 8 (15.68%) people. Localization of the process in subcardia and cardia, as well as in the prepyloric segment was not found in the main group. In the control group, during the Pit-Pattern white light examination, the patients were distributed as follows depending on the localization of the ulcerative process: body - 13 (30.23%) people; antrum - 15 (34.88%) people, duodenal cap - no patients, cardia and subcardia - 8 (18.60%); prepyloric segment –7 (16.27%).

The fourth task, assessing the degree of interconnection, is related to the fact that rank correlation coefficients (like most non-parametric estimates) are less sensitive to outliers and errors in the results of observations and, in this sense, are more stable and reliable measures of interdependence compared to the Pearson correlation coefficient. After calculating all the Spearman's rank correlation coefficients, they were ranked in absolute terms. The results of ranking the rank correlation coefficients between the indicators of the main group are presented in Tables 12 and 13.

Table 12

The relationship of indicators of endoscopic diagnosis of the mucous coat in polyps of the gaster and duodenum

	Name of the indicator	Glow		Deformation of the microstructure of the mucous coat	
		r	Rank	r	Rank
1	Revealed pathology	0.03812	11	-0.142206	7
2	Size	-0.03812	10	0.142206	6
3	NR	0.07143	9	-0.066607	8
4	Localization	-0.07230	8	-0.184943	5
5	Gender	0.12726	7	0.041534	10
6	Age	-0.15760	6	0.064772	9
7	Basis	0.15907	5	0.261069	4
8	Deformation of the microstructure of the mucous coat	0.46625	4	1.0000	
9	Subepithelial angioarchitecture	0.46625	3	-	-
10	Atrophy	0.69693	2	0.513415	1
11	Intestinal metaplasia	0.73837	1	0.475714	2
12	Glow	1.0000		0.466252	3

Table 13

The relationship of indicators of morphological state of the mucous coat in polyps of the gaster and duodenum

	Name of the indicator	Atrophy		Intestinal metaplasia	
		r	Rank	r	Rank
1	Age	-0.15295	7	-0.205111	9
2	Localization	-0.13352	8	-0.265373	5
3	Revealed pathology	-0.10096	10	-0.225201	8
4	Gender	0.05764	11	0.072608	11
5	Size	0.10096	9	0.225201	7
6	NR	0.15929	6	0.129454	10
7	Basis	0.17294	5	0.264804	6
8	Deformation of the microstructure of the mucous coat	0.51341	4	0.475714	4
9	Subepithelial angioarchitecture	0.51341	3	0.475714	3
10	Glow	0.69693	2	0.738369	2
11	Intestinal metaplasia	0.82068	1	1.0000	
12	Atrophy	1.0000		0.820689	1

On the basis of a comparative analysis of the samples of the main and control groups in the study of the effectiveness of the detection of polyps of the gaster and duodenum, it was concluded that the diagnostic efficiency of the innovative technology in detecting changes in the gastric mucosa with neoplastic potential is high.

IV. CONCLUSION

There is no doubt that at present only a comprehensive examination of patients using morphological methods of research can provide diagnostics of early stages of cancer, and the accuracy of diagnosis depends largely on the correct endoscopic interpretation of visible changes in the mucous coat and clear material for cytomorphological research, which, of course, promotes the use of innovative technology of narrow-band imaging.

In this regard, a study has been conducted, which allowed obtaining the following results: a logical algorithm has been proposed for selecting the most diagnostically significant capabilities of the EG-2990Zi video gastroscope and the EPK-i7000 Pentax video processor in the examination of the gastrointestinal tract, making a preliminary decision on the localization of the pathological process, choosing treatment and diagnostic tactics, with the utmost precision to determine the place of taking the biopsy material; the analysis of the main histological parameters in various types of chronic gastritis was carried out on the basis of the results of cytomorphological studies; a comparison of the analyzed histological data with endoscopic characteristics in various modes using innovative technologies made it possible to assess the degree of risk factors for the development of neoplastic changes in the gastric mucosa.

The presented materials can be used to optimize treatment and diagnostic care for patients with chronic gastritis.

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