

**O.M. Babii, N.V. Prolom, B.F. Shevchenko, S.O. Tarabarov, N.V. Poliak,
D.F. Mylostyva, N.P. Dementii**
SI "Institute of gastroenterology of NAMS of Ukraine", Dnipro

ARGON PLASMA COAGULATION IN THE TREATMENT OF BARRETT'S ESOPHAGUS IN COMBINATION WITH HIATAL HERNIA

e-mail: Aleksandr_babiy@ukr.net

141 patients were examined in the Department of Digestive Surgery of the SI "Institute of gastroenterology of NAMS of Ukraine" in 2017–2022 to improve the treatment tactics of Barrett's esophagus with hernias of the esophageal opening of the diaphragm. All patients were diagnosed with hiatal hernia by X-ray examination. The diagnosis of Barrett's esophagus was confirmed by an endoscopic examination with an NBI mode and high-resolution (HD) device, with a visual assessment of the condition of the esophageal mucosa and the sampling of biopsies for histological examination. In 5 (3.2 %) cases, cylindrical cell metaplasia of the esophagus was diagnosed with signs of intestinal metaplasia and mild dysplasia. A two-stage treatment method was chosen: the first one – argon plasma coagulation of the esophageal mucosa, and the second – elimination of hiatal hernia during elective antireflux surgery.

Key words: cylindrical cell metaplasia of the esophagus, hernia, endoscopic and morphological diagnostics, coagulation, anti-reflux operations.

**О.М. Бабій, Н.В. Пролом, Б.Ф. Шевченко, С.О. Тарабаров, Н.В. Поляк,
Д.Ф. Милостива, Н.П. Дементій**

АРГОНОПЛАЗМОВА АБЛЯЦІЯ ПРИ ЛІКУВАННІ СТРАВОХОДУ БАРРЕТТА В ПОЄДНАННІ З ГРИЖЕЮ СТРАВОХІДНОГО ОТВОРУ ДІАФРАГМИ

Для удосконалення тактики лікування стравоходу Барретта при грижах стравохідного отвору діафрагми у відділі хірургії органів травлення ДУ «Інститут гастроентерології НАМН України» у 2017–2022 роках обстежено 141 пацієнта. Усім пацієнтам встановлено діагноз грижі стравохідного отвору діафрагми за допомогою рентгенологічного дослідження. Діагноз стравоходу Барретта підтверджено ендоскопічним дослідженням апаратом з режимом NBI та високим розрішенням (HD), з візуальною оцінкою стану слизової оболонки стравоходу та проведенням забору біоптатів для гістологічного дослідження. У 5 (3,2 %) випадках діагностовано циліндроклітинну метаплазію стравоходу з ознаками кишкової метаплазії і дисплазією легкого ступеня. Обрано двохетапний метод лікування: перший – аргоноплазмозна абляція слизової стравоходу, другий – усунення грижі стравохідного отвору діафрагми при плановому антирефлюксовому оперативному втручанні.

Ключові слова: циліндроклітинна метаплазія стравоходу, грижа, ендоскопічна та морфологічна діагностика, абляція, антирефлюксні операції.

The work is a fragment of the research project "To study the features of the complicated course of the hiatal hernia, gastroesophageal reflux disease, esophageal achalasia, stenosis of the gastroduodenal zone of ulcer genesis and to improve the methods of their surgical correction with the use of endolaparoscopic technologies", state registration No. 0119U102471.

Intestinal metaplasia, or Barrett's esophagus, is an acquired condition that develops due to replacing the multilayered squamous epithelium of the lower part of the esophagus with a specific cylindrical epithelium. It is one of the complications of gastroesophageal reflux disease (GERD) in chronic damage to the esophageal mucous membrane (MM) as a result of contact with reflux components [11, 13]. The prevalence of Barrett's esophagus varies significantly in different regions of the world, and Barrett's esophagus is diagnosed in 2.2–8.5 % of patients undergoing screening endoscopic examination and in 12–20 % of patients with GERD [9, 14]. Barrett's esophagus is one of the complications of GERD. It occurs in most cases against the hiatal hernia (HH) background. It occupies a leading position among all benign pathologies of the esophagus and ranks 2–3 in the structure of gastrointestinal tract morbidity [5, 12, 15].

The primary method of diagnosing Barrett's esophagus in the case of HH is an endoscopic examination with a biopsy of areas of the esophageal MM and subsequent histological examination. The endoscopic examination of a newly formed gastroesophageal junction in the esophagus is well visualized since the surface of the cylindrical epithelium is redder and darker than the squamous epithelium. NBI endoscopy ("narrow band imaging") is of great importance in the diagnosis of Barrett's esophagus [1, 3]. This method makes it possible to evaluate the microstructure and character of MM's vascular pattern, which helps diagnose intestinal metaplasia and dysplasia of the epithelium and perform targeted biopsy [6, 7, 10].

During the histological examination of MM areas of cylindrical metaplasia, the metaplastic epithelial cover can be represented by a cardiac type of epithelium, areas with acid-producing MM and

areas with goblet cells. In these areas, intestinal metaplasia can be represented as a complete type (I) or an incomplete type (II or III). In addition, it includes elements that are intermediate between gastric cells and intestinal goblet cells. Therefore, it is called a specialized epithelium [6, 8, 10].

Considering the combination of HH and GERD with Barrett's esophagus, developing the most optimal treatment options for patients with this pathology is ongoing. The main goal of treatment is to eliminate not only the clinical manifestations of GERD but also the elimination of all histological signs of MM damage characteristic of Barrett's esophagus [7]. One of the endoscopic methods is the use of high-energy lasers. Due to the lack of direct contact with MM, laser ablations are more easily tolerated by patients than electrocoagulation. However, the complication rate after argon plasma coagulation (APC) is 9–15 %. The main indication for APC in Barrett's esophagus is the presence of dysplasia in the area of cylindrical metaplasia of the esophageal MM [7]

Because the development of Barrett's esophagus is based on gastroesophageal reflux, most surgeons consider it necessary to perform antireflux operations (various types of fundoplication, crurorrhaphy) using traditional or laparoscopic methods [2, 9, 10]. The main task of surgical treatment of HH and GERD is the correction of anatomical and physiological disorders: hernia removal and correction of the antireflux function of the cardia, thanks to fundoplication and crurorrhaphy [1, 4].

Unfortunately, today there are no precise approaches to determining treatment tactics for patients with HH in combination with Barrett's esophagus. The development of the most optimal treatment options for such patients continues.

The purpose of the study was to improve the tactics of Barrett's esophagus treatment for hiatal hernias using argon plasma coagulation.

Material and methods. In 2017–2022, 141 patients with HH were examined in the Department of Surgery of the Digestive Organs of the State Institution “Institute of Gastroenterology of NAMS of Ukraine”. Of them, 44 (31.2 %) were male patients, and 97 (68.8 %) were female aged 21–70 (36.5±4.2) years. All patients signed informed consent to participate in this study.

X-ray examination of the esophagus and stomach was performed to establish or confirm the HH diagnosis in patients. The X-ray examination consisted of an inspection X-ray and X-ray on the OPERA T90 CEX machine with the use of barium sulfate (ATC code VO8BF02). Special methods and techniques were used to detect insufficiency of the physiological cardia.

All patients underwent esophagogastroduodenoscopy (EGD) using the EVIS EXERA III OLYMPUS 190 device (with NBI and HD modes). The severity of inflammatory and structural changes, including HH, was assessed in the esophagus. The degree of esophageal MM inflammation was assessed according to the Los Angeles classification.

Cylindrical esophageal metaplasia of MM was determined in the presence of a Z-line raised by more than 1 cm (the line of transition of the squamous epithelium to the cylindrical one). It was localized proximal to the anatomical junction of the esophagus and stomach (top of the gastric folds) with the formation of a particular segment of the esophagus covered with metaplastic cylindrical epithelium (columnar-lined esophagus – CLE), which looks like bright pink pathological areas against the background of pale pink esophageal MM above the cardioesophageal junction (“tongues of flame”). The Prague classification “C and M” was used to describe Barrett's esophageal segment, where C is the circular length, and M is the maximum length of the prevalence of esophageal cylindrical MM epithelium. Taking into account the distance to the circular coverage of the Z-line of the esophagus and the most distant point of the longest “tongue”, these criteria allow us to more accurately describe the prevalence of cylindrical epithelium of the esophageal MM, increasing the probability of detecting specialized intestinal metaplasia, dysplasia. When viewed in a narrow band imaging (NBI) with magnification, the microstructure of the MM surface lining the esophagus was visualized to determine the presence of signs of intestinal metaplasia and confirmation of Barrett's esophagus. In addition, chromoendoscopy with a 1.5 % acetic acid solution was used to increase visualization of the relief of areas of cylindrical metaplasia in the esophagus.

Morphological examination was performed to establish the diagnosis and determine the management tactics of patients with Barrett's esophagus. At least 4 MM biopsies of different areas of endoscopically visible lesions of the esophageal MM were performed (at a distance of about 1 cm from each other, 2 cm proximal to the Z-line).

For paraffin histological preparations, the biopsy material was fixed in a 10 % neutral formalin solution, dehydrated in increasing concentration alcohols, and paraffin blocks were made. To study the general histological structure of the esophagus, sections 5–7 microns thick were stained with hematoxylin-eosin according to the standard method.

According to international recommendations [4, 6, 10], patients with Barrett's esophagus with the presence of MM dysplasia in CLE areas are indicated for the ablation of affected areas using APC, which was performed on a Zoring ARCO 3000 device (Germany) during an endoscopic examination with intravenous sedation. The endoscopic APC technique consisted of the following stages: examination with assessment of the necessary volume of ablation, injection into the submucosal layer of physiological solution to create a protective lifting, and ablation of selected areas of CLE. During one session, argon plasma coagulation of MM was performed on 1/3 of the esophagus. The timing of the next coagulation session depended on the results of the control endoscopy and histological signs of esophageal MM healing, which averaged 2 months.

The number of endoscopic argon plasma coagulation sessions depended on the size of cylindrical metaplasia segments and ranged from 2 to 4 times. The first endoscopic control was performed 2 months later. In the absence of inflammatory processes in the esophageal MM, endoscopic argon plasma coagulation was recommended to eliminate residual segments of CLE. An average of 3 coagulation sessions were performed against the constant administration of proton pump inhibitors. 2 months after the last session of endoscopic argon plasma coagulation in cases of complete elimination of CLE foci, patients were referred for planned surgical treatment with antireflux surgical interventions. 6 months after surgical treatment, a control endoscopic examination was performed.

Results of the study and their discussion. During X-ray examination, axial HH (type I) was diagnosed in 115 (81.5 %) patients, paraesophageal (type II) – in 20 (14.2 %) patients, and mixed (type III) – in 6 (4.3 %). Depending on the amount of penetration of organs from the abdominal cavity into the thoracic cavity, 1st-degree HH was determined in 90 (63.8 %) patients, 2nd-degree – in 37 (26.2 %) patients and 3rd-degree – in 14 (10.0 %) patients.

Endoscopic examination of the examined patients confirmed the presence of HH in all cases. The characteristic endoscopic signs of HH were: a decrease in the distance from the anterior incisors to the cardia – in 13 (14.3 %) cases, the presence of a hernial cavity, a "second entrance" to the stomach – in 20 (14.1 %) cases; gaping or incomplete closure of the cardia – in 76 (53.9 %) cases; prolapse of the mucous membrane of the stomach into the esophagus – in 44 (33.6 %) cases; cardiac folds of the 3rd and 4th degrees were found in 86 (69.4 %) and 6 (4.8 %) cases, respectively.

During the endoscopic examination of the esophagus, 5 (3.2 %) patients with type 1 HH were diagnosed with cylindrical metaplasia of the esophagus with signs of intestinal metaplasia (Barrett's esophagus) without symptoms of reflux esophagitis (fig. 1).

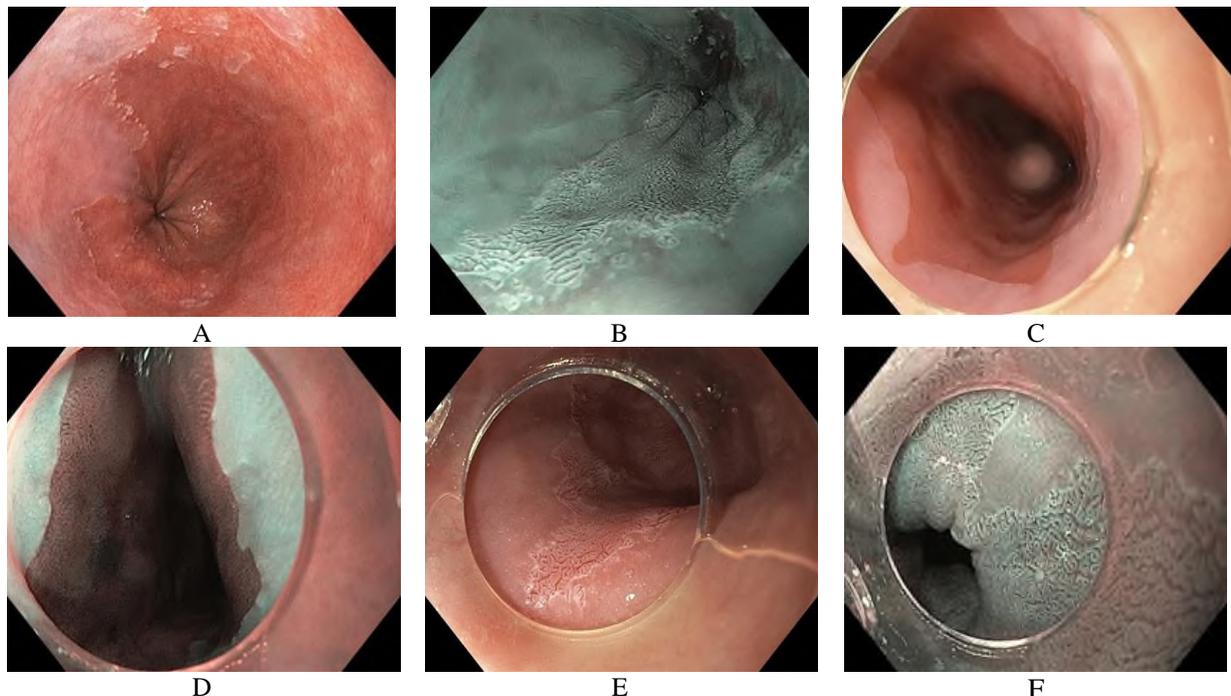


Fig. 1. Cylindrical metaplasia of the esophageal mucosa with signs of intestinal metaplasia (Barrett's esophagus): A, C, E – endoscopy in endoscopy in the normal mode; B, D, F – endoscopy in NBI mode.

In all cases of Barrett's esophagus, signs of intestinal metaplasia were found in CLE with MM dysplasia, which was confirmed morphologically (mild dysplasia) (fig. 2).

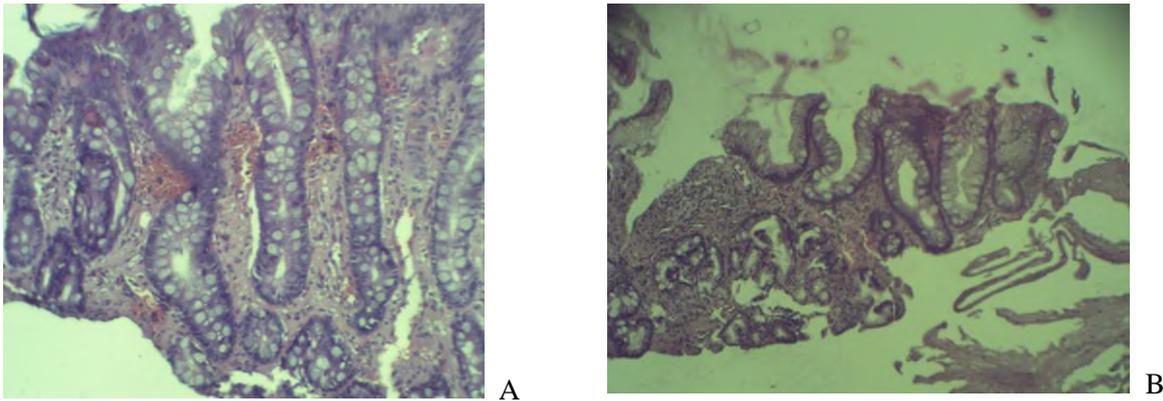


Fig. 2. A – Histological examination of the biopsy material of the esophageal mucosa (section of cylindrical metaplasia): a) intestinal metaplasia in the segment of the esophagus with goblet cells and areas of dysplasia, X200. Hematoxylin-eosin staining. B – Histological examination of the biopsy material of the esophageal mucosa six months after the last stage of argon plasma coagulation. The structure of the esophageal mucosa is preserved. Chic reaction, 100X magnification.

The stages of APC in Barrett's esophagus are shown in fig. 3.

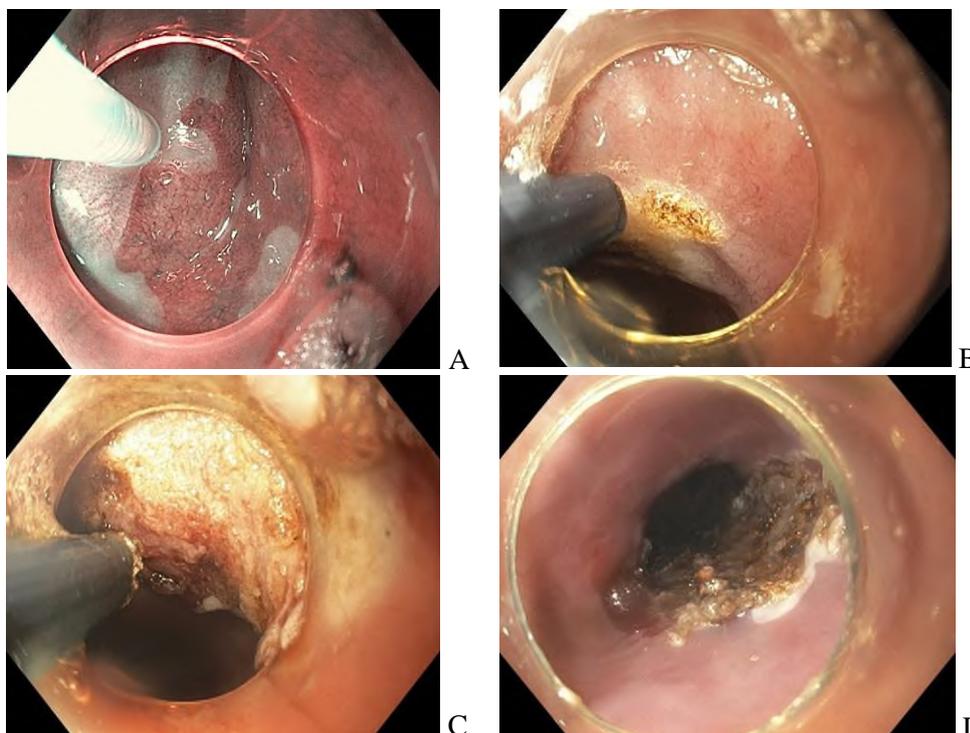


Fig. 3. Patient K. Endophotography. Stages of argon plasma coagulation in Barrett's esophagus (study using a plastic cap): a – endoscopic argon plasma coagulation in NBI mode, B – endoscopic argon plasma coagulation in normal mode, C – endoscopic argon plasma coagulation of 1/3 of the esophageal mucosa in normal mode, D – endoscopic argon plasma coagulation of the esophageal mucosa after the first previous session in normal mode.

Six months after the last stage of APC, an endoscopic control examination with a biopsy was performed. In all cases, after APC, the disappearance of circular and "tongue" segments were revealed, with epithelialization at the site of CLE by squamous epithelium confirmed morphologically (fig. 2).

The results of an endoscopic examination of Barrett's esophagus 2 months after the last APC session are presented in fig. 4.

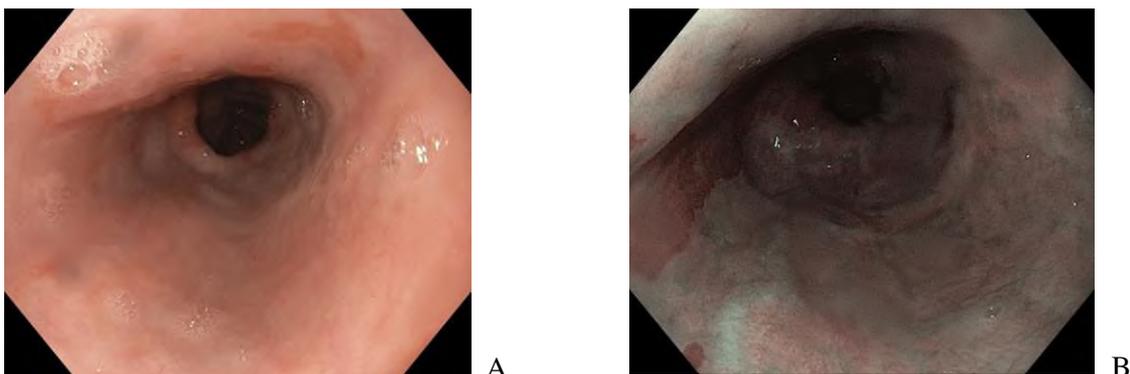


Fig. 4. Barrett's esophagus after argon plasma coagulation: A – endoscopy in conventional mode, B – endoscopy in NBI mode.

2 months after the last APC session, patients were referred for scheduled antireflux surgery against the background of the complete elimination of CLE foci. We have proposed a new method of surgical correction of the failure of the physiological cardia in HH and GERD. It eliminates these shortcomings and is aimed at preserving and restoring anatomical and topographic relationships between the diaphragm and the esophageal-gastric junction zone ("Surgical correction of the failure of the physiological cardia in hiatal hernias", published in the journal *Gastroenterology: a collection of scientific articles*. 2021. Volume 55, No. 1, Pp. 51–60).

In the long-term postoperative period after performing anti-reflux operations with the restoration of the physiological cardia in the observation period of up to 6 months among the examined patients (n=5), according to the data of endoscopic and X-ray screening, no signs of recurrence of HH and Barrett's esophagus were detected.

HH ranks first in terms of prevalence in modern gastroenterology in the "esophageal diseases" section. This pathology is often combined with reflux esophagitis of varying degrees of severity and, in some cases, with cylindrical metaplasia of the esophageal MM, including Barrett's esophagus. It occurs as a response to chronic inflammation of the MM and submucosal layers. It is characterized by replacing the multi-layered squamous epithelium of the distal part of the esophagus with a cylindrical one with intestinal metaplasia [3]. Because Barrett's esophagus is considered a precancerous condition, timely diagnosis of this disease and the development of methods of its treatment remain relevant [11, 12, 13].

To date, several surgical treatment strategies for HH aimed at correcting anatomical and physiological disorders have been developed and implemented in the world: eliminating hernia, restoring the anti-reflux function of the cardia due to fundoplication and crurorrhaphy, ensuring a free antegrade passage of food [2, 12]. But the choice of treatment tactics for patients with HH combined with Barrett's esophagus is currently debatable, and the development of the most optimal options for treating such a combined pathology is ongoing. After all, in this category of patients, the goal of treatment is not only to eliminate the clinical manifestations of GERD by eliminating the cause of reflux but also to achieve regression of Barrett's esophagus segments [1, 3].

In recent years, significant progress has been made in developing endoscopic methods for treating Barrett's esophagus. One of the endoscopic methods is the use of high-energy lasers. Due to the lack of direct contact with MM, laser ablation is more easily tolerated by patients than electrocoagulation [1].

Because the development of Barrett's esophagus is based on gastroesophageal reflux, most surgeons consider it necessary first to perform antireflux operations (types of funduplications with crurorrhaphy) using "classical" laparoscopic methods [2, 3].

Endoscopic methods of treating areas of intestinal metaplasia and dysplasia are sufficiently widely covered in the literature and represent an effect on the changed epithelium: implantation of inert materials, multipolar electrocoagulation, laser destruction, photodynamic therapy, argon plasma coagulation, cryodestruction, MM resection [3, 12]. We applied the APC method due to the thermal effect of a high-frequency current applied to the tissue by a stream of ionized argon plasma. According to specialists, complications with the use of APC occur significantly less than with the help of electric and laser destruction [14].

Two months after the last APC session, patients were scheduled to undergo antireflux surgery against the complete elimination of CLE foci (cardiocrurorrhaphy, fundocruoesophagorrhaphy, cardiogastropliation with gastroduaphragmopexy) laparoscopically. The need to operate to restore the antireflux function of the physiological cardia is because even with a decrease in gastric secretion with the help of proton pump inhibitors, the reflux of gastric contents (including bile) into the esophagus persists, which can again lead to the transformation of the epithelium in the lower third of the esophagus [2, 14].

We examined patients 6 months after anti-reflux surgery and performed an endoscopic control examination. In all cases, the absence of signs of HH with the disappearance of circular and "tongue" segments of CLE was found, i.e., epithelization of metaplasia segments with squamous epithelium was observed as a result performing APC.

Conclusion

Barrett's esophagus was detected in 3.2 % of cases among examined patients with HH only when combined with axial HH (type I). According to endoscopy data, Barrett's esophagus was characterized by cylindrical metaplasia with signs of intestinal metaplasia without symptoms of reflux esophagitis. According to morphological data, Barrett's esophagus was characterized by intestinal metaplasia in CLE with MM dysplasia.

Using the proposed two-stage treatment method, namely, argon plasma coagulation (first stage) and antireflux surgery (second stage), allowed to improve treatment tactics, which contributed to the regression of the affected MM segments in Barrett's esophagus and prevented gastroesophageal reflux.

Prospects for further research. Continuation of the study, the study of distant treatment results after 3–5 years.

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