

THE USE OF ARGON PLASMA COAGULATION IN ENDOSCOPY

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ABSTRACT

Relevance: Argon plasma coagulation (APC) is a minimally invasive, non-contact electro-surgery method. This procedure is performed in the following conditions: bleeding in hollow organs, including ulceration after radiation therapy, Barrett's esophagus, with the germination of a malignant tumor through a stent, benign neoplasms, precancerous conditions, and some malignant tumors at the earliest stages. In this article, the authors present the first successful experience of using APC in Kazakhstan during endoscopic interventions in patients with various pathologies.

The study aimed to evaluate the effectiveness of introducing APC as an endoscopic treatment in patients with precancerous pathology and complications of surgical treatment in oncological patients.

Methods: A retrospective analysis of the use and effectiveness of APC involved 15 patients with various pathologies treated inpatiently at the National Research Oncology Center (NROC), Astana, Kazakhstan, in 2022.

Results: Barrett's esophageal APC was successfully performed in the NROC hospital in 6 patients; the biopsy showed no intestinal-type metaplasia of the esophageal epithelium. Two patients with post-radiation hemorrhagic proctitis underwent coagulation in Pulse 15Wt mode and argon flow of 0.4-1.0 L/min. A patient with GAVE syndrome with hemorrhages underwent two sessions of APC in 35Wt mode with a gas flow of 0.8 L/min. In 3 patients with fistulas of the suture of the main bronchus, coagulation was performed after pneumectomy, and closure of the fistula was observed for one week. Two patients with esophagus-enteric anastomosis failure received two sessions of APC with 40-watt argon at a 5-day interval. After anterior rectal resection, the patient had a failure of the anastomosis with a multi-chamber cavity and purulent contents. Four courses of APC were administered with a 2-week interval. After APC, the mouth of the main chamber narrowed, and the discharge of pus stopped. The result was a blind pocket up to 2.0 cm, without additional chambers or inflammation signs.

Conclusion: The presented article describes the results of the introduction of APC as an endoscopic method of treating patients with various pathologies in an oncological clinic, and based on these results, APC can be recommended for widespread implementation throughout Kazakhstan.

Keywords: argonoplasmic coagulation (APC), Barrett's esophagus, endoscopy, neoplasms, anastomosis failure.

Introduction: Argon plasma coagulation (APC) is a minimally invasive, non-contact electro-surgery method. During this procedure, the tissue is exposed to high-frequency electrical energy delivered by ionized argon gas. An argon plasma torch is created by an electric current that strongly heats the tissue. As a result, the liquid evaporates, the proteins coagulate, and the tissue completely burns out. This process is called coagulation.

APC is used in all areas of surgery, including cancer. This procedure is performed in the following patient conditions:

- Bleeding in hollow organs, including ulceration, esophagus varicose veins, and postradiation proctitis;
- Barrett's esophagus, a precancerous condition when uncharacteristic intestinal-type epithelium is found in the esophageal mucosa;
- Germination of tumor tissue into the lumen of the stent – APC is used for recanalization;
- Benign neoplasms and some malignant neoplasms in the early stages;
- A progressive malignant tumor that clogs the lumen of a hollow organ. APC is used as palliative treatment in this case;
- Gynecological pathologies: Erosion and dysplasia of the cervix, polyps, papillomatosis, hyperkeratosis, condylomas, leukoplakia.

For the patient, APC looks like a regular endoscopic examination. The operation usually takes less than an hour and can be performed without hospitalization. The coagulation device is a metal rod electrode placed inside a tube filled with argon. When alternating current is applied to the electrodes, argon transforms into a plasma state, producing flashes resembling sparks or miniature flashes. This "lightning" is used instead of a scalpel. The tool does not touch the tissue; the distance is 2-10mm [1].

This article presents the first and most successful experience of using APC in Kazakhstan during endoscopic interventions in patients with precancerous and oncological pathologies.

Materials and methods: This work is part of a retrospective study that assesses endoscopic technologies' efficiency in treating patients with pretumor pathology and complications of surgical treatment in cancer patients. The medical histories of patients treated in the multidisciplinary surgery department of the National Research Oncology Center (NROC, Astana, Kazakhstan) were retrospectively analyzed.

The study included patients with the following diagnoses:

1. Barrett's esophagus with signs of low-grade dysplasia;
2. Gastric arteriovenous malformation (GAVE syndrome) with recurrent gastric bleeding;

3. Esophageal anastomosis failure is not more than 0.5 cm and is not amenable to endoscopic clipping;

4. Bronchial stump suture failure up to 0.5 cm after pneumonectomy;

5. Rectal anastomosis failure in the presence of a functioning colostomy;

6. Chronic proctitis grade 2-3 according to the post-radiation proctitis severity scale (Rectal Toxicity Scale, 1995), proposed by the Radiation Therapy Oncology Group (RTOG) and the European Organization for Research and Treatment of Cancer (EORTC);

7. Bleeding from the rectum, which is often an indication for blood transfusion;

8. Ineffective conservative therapy with 5-aminosalicylic acid (5-ASA) and rectal glucocorticosteroids for 30 days.

Exclusion criteria:

1. Barrett's esophagus with severe dysplasia;

2. Diffuse arteriovenous malformation of the stomach without bleeding events;

3. Esophageal anastomotic failure greater than 0.5 cm and amenable to endoscopic clipping;

4. Bronchial stump failure more than 0.5 cm requiring surgical treatment;

5. Chronic post-radiation proctitis without signs of rectal bleeding;

6. Severe general condition.

The following parameters of the early postoperative period (Days 0-7 after APC) were assessed: the clinical APC effect includes stopping bleeding from the rectum in chronic post-radiation proctitis, the absence of gastric bleeding events in patients with arteriovenous malformation of the stomach, and the cessation of airflow through the Bulau catheter in patients with broncho-

pleural fistulas, terms of inpatient treatment, patients' quality of life.

Changes in the patient's quality of life after APC were assessed according to certain parameters: discomfort, pain, and number of bowel movements per day.

No complications were recorded in all patients after APC use.

Findings were statistically processed with the Statistica 6.0 applied software package (StatSoft, Inc., USA) and the statistical criteria online calculator at medstatistic.ru.

The study conclusion report of the National Research Oncology Center local ethics commission was received on May 20, 2023, under number No. 12. Informed consent was obtained from all patients who underwent medical and surgical interventions in NROC and whose data was included in this review article.

Results:

Barrett's esophagus APC

APC is the most effective method of endoscopic treatment for Barrett's esophagus without severe dysplasia (pronounced changes in the mucous membrane cells) and malignant degeneration. Data shows that if the length of the affected organ area is not more than 3-4 cm, the APC effectiveness is 80-90% [2]. From May 2021, since the introduction of APC in the Scientific Research Center as an endoscopic ablation method for Barrett's esophagus, the multidisciplinary surgery department of the Scientific Research Center has successfully performed endoscopic treatment of Barrett's esophagus in 6 patients (Figure 1). Subsequent endoscopic monitoring with a collection of biopsy material did not find any signs of intestinal-type metaplasia of the esophageal epithelium in the morphological material.

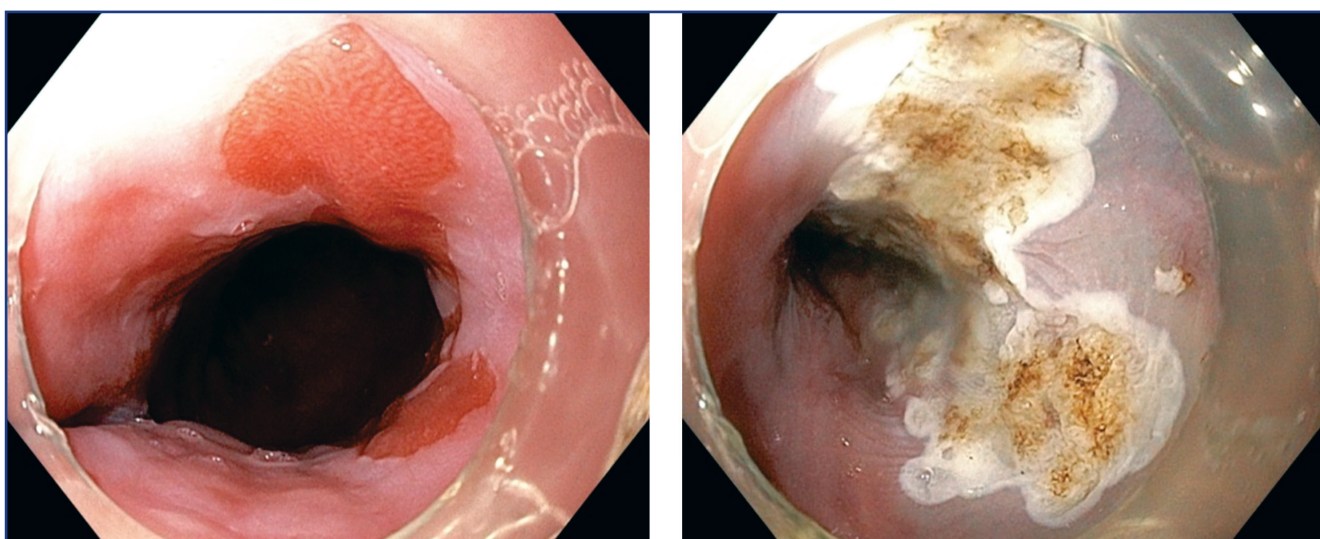


Figure 1 – APC application in Barrett's esophagus

Rectum APC in chronic post-radiation proctitis

APC is highly effective for chronic post-radiation proctitis, a pelvic organ radiation treatment complication. The disease causes the rectum bleeding and is recalcitrant. The frequency of this symptom in patients with pelvic cancer

was 5-15% within six months after radiation treatment.

In the NROC multidisciplinary surgery department, endoscopic APC treatment was given to two patients with post-radiation proctitis complicated by bleeding (Figure 2). Rectal bleeding events stopped after the 1st session

of argon coagulation in a man after radiation therapy for bladder cancer and in a woman after radiation therapy for cervical cancer. In order to stop bleeding, all patients un-

derwent APC of the rectal mucosa with areas of angioectasias with 15 Watts Pulse mode and an argon flow of 0.4-1.0 L/min.

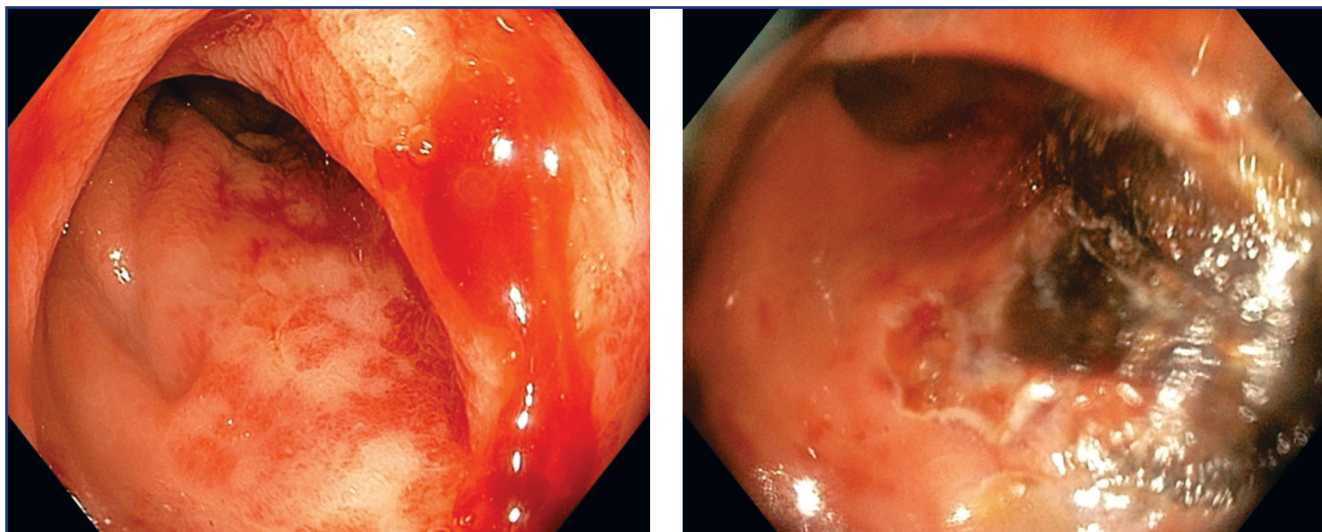


Figure 2 – Application of APC for post-radiation proctitis

APC in arteriovenous malformations of the gastrointestinal tract mucous membrane

Gastric antral vascular ectasia (GAVE) is a rare acquired vascular lesion of the gastric antrum. Iron deficiency anemia is the most common manifestation of GAVE. Endoscopic therapy is the mainstay of treatment. However, no consensus exists on the optimal treatment method [3].

Endoscopic treatment of a patient with GAVE syndrome suffered from gastric bleeding events with a decrease in hemoglobin to 49 g/L was performed successfully in our department. This patient underwent two APC sessions in 35 Wt coagulation mode with 0.8 L/min gas flow and had no bleeding episodes for two years after ablation (Figure 3).

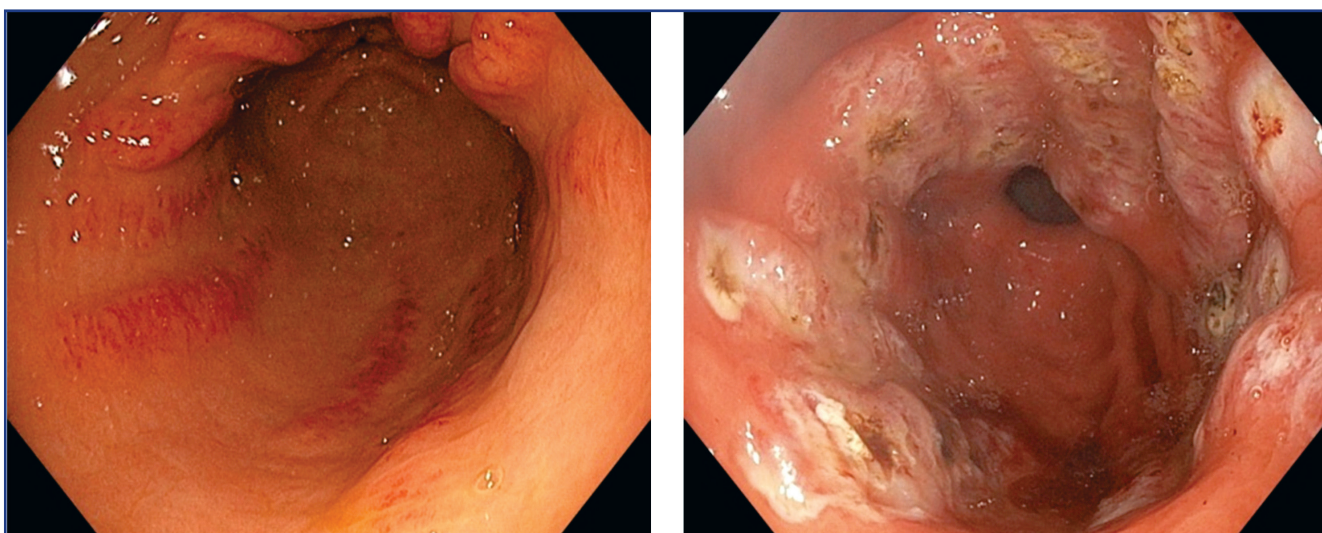


Figure 3 – APC application for GAVE syndrome

APC in bronchial stump suture failure

Tracheo mediastinal fistula is a rare complication arising from lung cancer. These airway fistulas are often connected with the esophagus or pleural cavity. The bronchopleural fistula etiology is different. However, lung resection, various infections, chemotherapy, and radiation therapy, among others, are used to treat lung cancer; spontaneous

persistent pneumothorax and tuberculosis are usually associated factors.

Most fistulas associated with lung cancer develop as a complication of lung resection [4].

Three patients with bronchopleural fistulas of the main bronchus stump suture after pneumonectomy were treated endoscopically in the NROC multidisciplinary surgery

department. The fistula opening was coagulated circumferentially using a 40-watt coagulator (Olympus, Japan),

and the opening has closed within one week after the procedure (Figure 4).

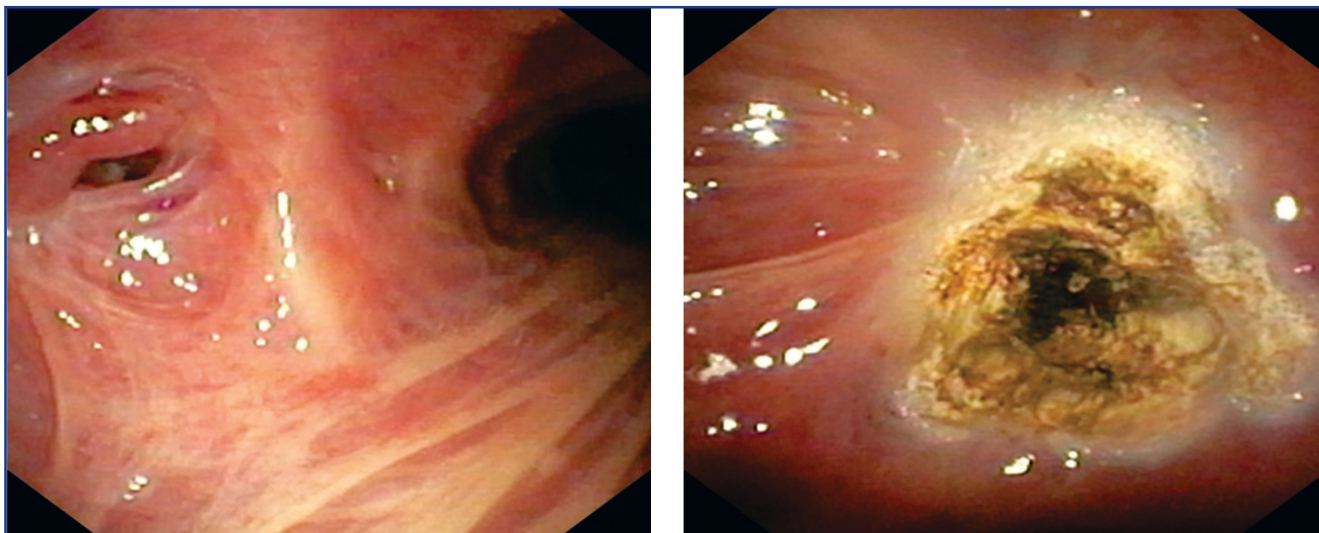


Figure 4 – APC for the main bronchus stump fistulas after pneumonectomy

APC in esophageal anastomosis failure

Suture failure occurs in 0.5-33% of esophagogastric anastomosis. The failure of esophagointestinal anastomosis develops in 5.9-12% of patients who underwent gastrectomy and is accompanied by high mortality, which approaches 100%. One of the most compelling prerequisites for developing esophageal anastomosis failure is a violation of the nutritional status of patients who need surgical operations in the upper gastrointestinal tract. We should not forget about the role

of technical errors: misalignment of the mucous membranes, very frequent sutures, excessive tight knotting, needle piercing of the mucous membranes during the formation of the second row of sutures, the tension of the sutured organs, etc. [5].

Two patients with failed esophagojejunostomy after gastrectomy underwent endoscopic treatment using a 40-watt APC at the NROC clinic. Successful fistula closure took two sessions with an interval of 5 days (Figure 5).

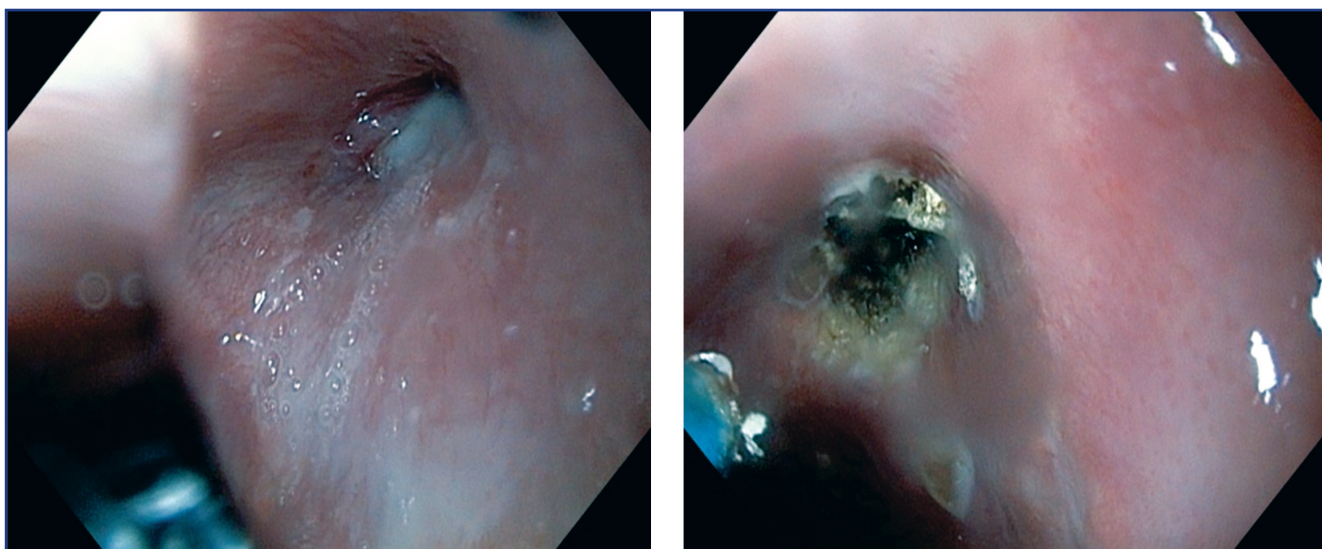


Figure 5 – Application of APC for esophageal anastomosis failure

APC for rectal anastomosis failure

Failure of the rectum anastomosis, one of the most severe complications, occurs in 1.5-1.0% of rectum resection, and the associated postoperative mortality reaches 6.0-9.3%. Both intraoperative and preoperative

risk factors determine the development of complications. The height of the tumor location, radiation therapy exposure, male gender, and smoking are important predisposing factors for the development of rectal anastomotic failure.

APC was used in a patient after anterior resection of the rectum for rectal cancer at the NROC multidisciplinary surgery department. Anastomosis failure with a multi-chamber cavity with numerous mouths and purulent contents was found in the patient at the control colonoscopy 3rd month after the operation. 40-watt APC was

performed in 4 courses with 2-week intervals. After endoscopic treatment, small mouths and cavities closed, the main chamber mouth significantly decreased, and the release of purulent contents stopped. A blind pocket up to 2.0 cm without additional chambers or inflammation signs remained after treatment (Figure 6).

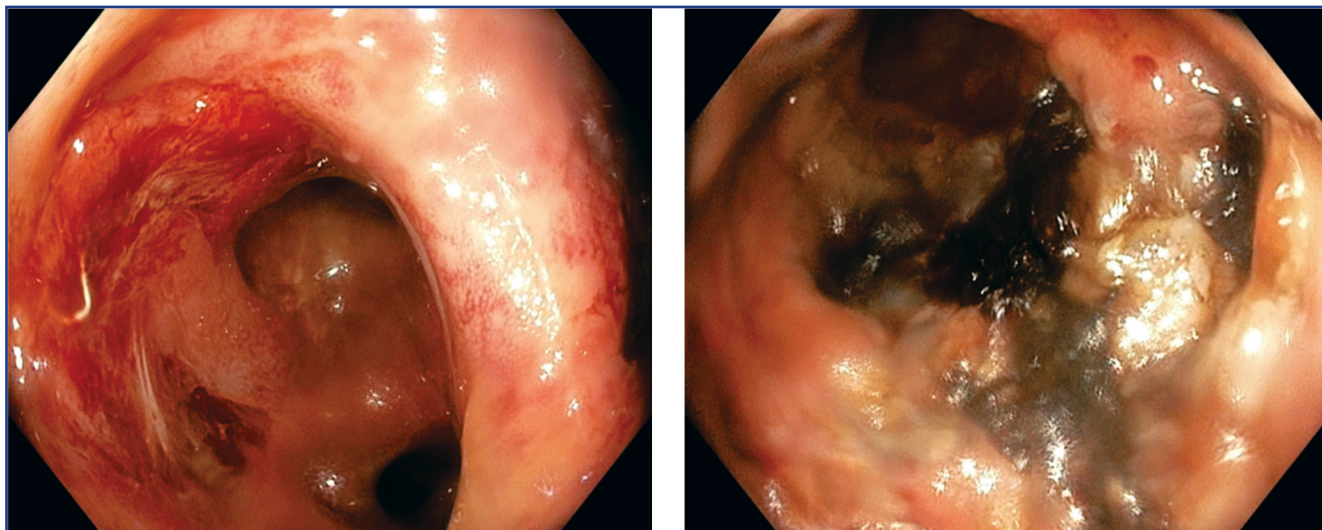


Figure 6 – APC application for rectal anastomosis failure

No complications were recorded in all patients after using APC in the early postoperative period. APC was performed on an outpatient basis in patients with post-radiation proctitis and rectal anastomosis failure. On average, patients with

Barrett's esophagus and GAVE syndrome stayed in a hospital for 2.2 days. APC usage in patients with esophageal anastomosis failure, main bronchus stump failure, and rectal anastomosis failure averaged 8 to 14 days (Table 1).

Table 1 – Criteria for the effectiveness of the APC application

Nosology	Barrett's esophagus	Post-radiation proctitis	GAVE syndrome	Bronchial fistula	Esophageal anastomosis failure	Rectal anastomosis failure
Clinical effect	+	+	+	+	+	+
Presence or absence of complications	-	-	-	-	-	-
Length of stay in hospital	2.2±0.69	out-patient treatment	2.0	8.0±0.82	14±2.0	out-patient treatment
Presence of relapse	-	-	-	-	-	-

Discussion: Endoscopic techniques described in the literature, such as electrocoagulation, ligation of vascular transformations, and radiofrequency ablation, have not been widely used due to the small amount of data on their effectiveness and safety.

APC is a non-contact electrocoagulation method that uses ionized gas to deliver high-frequency alternating current to the lesion. The risk of perforation, stenosis, or fistula is low due to the shallow coagulation depth of 0.5-3 mm. Unlike traditional bipolar devices, the APC can be applied in the axial and radial directions, which allows tangential coagulation of lesions around the flexures of the rectum without significant loss of efficiency. In addition,

the APC generator is mobile and can be quickly used anywhere and anytime. Thus, APC is an established treatment for many pathologies, including vascular dysplastic lesions and bleeding from polypectomy areas. Additionally, APC therapy does not require sedation or anesthesia during the procedure and, therefore, can be performed in an outpatient setting.

The advantages of APC include ease of use, targeted coagulation of telangiectasia and fistulas, depth control and safety, and lower cost compared to radiofrequency ablation. The advantages of APC include the ability to rotate the probe in axial and radial directions that enable adequate coagulation

of the mucous membrane of the esophagus, stomach, bronchi, and rectum in curved areas.

Conclusion: The authors presented cases of successful and, most importantly, clinically effective use of APC as an endoscopic minimally invasive treatment for surgical treatment complications in patients with oncological and non-oncological pathologies in this clinical review. The endoscopic treatment method was often chosen due to the concomitant pathology, the patient's general condition that did not allow surgical treatment, and the possibility of conducting argon coagulation sessions on an outpatient basis without hospitalization. Based on the study results, we can recommend the widespread use of APC in all oncological and surgical hospitals for minimally invasive treatment of such complications.

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АНДАТПА

ЭНДОСКОПИЯДА АРГОНОПЛАЗМАЛЫҚ КОАГУЛЯЦИЯНЫ ҚОЛДАНУ

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Өзектілігі: Аргоноплазмалық коагуляция (АПК) – электрохирургияның аз инвазивті байланыссыз әдісі. Бұл процедура келесі жағдайларда орындалады: қуыс мүшелердегі қан кетулер, соның ішінде сәулелік терапиядан кейінгі ойық жара, барреттің өңеші, стент арқылы қатерлі ісіктің өнуі, қатерсіз өсінділер, қатерлі ісікке дейінгі жағдайлар, кейбір қатерлі ісіктер. Бұл мақалада авторлар әртүрлі патологиясы бар пациенттерге эндоскопиялық араласу кезінде Қазақстанда АПК қолданудың алғашқы және табысты тәжірибесін ұсынады.

Зерттеудің мақсаты – қатерлі ісікке дейінгі патологиясы бар және онкологиялық науқастарда хирургиялық емдеудің асқынулары бар емделушілерде эндоскопиялық ем ретінде АПК енгізудің тиімділігін бағалау.

Әдістері: 2022 жыл ішінде Ұлттық ғылыми онкологиялық орталықта (ҰҒОО, Астана, Қазақстан) стационарлық емдеуде болған әр түрлі патологиясы бар 15 пациентте АПК қолдану мен тиімділігіне ретроспективті талдау жүргізілді.

Нәтижелері: ҰҒОО стационарында 6 пациентке барреттің өңеш АПК сәтті жүргізілді, бақылау кезінде биопсиялық материалда ішек типі бойынша өңеш эпителийінің метаплазиясының белгілері анықталмады. Радиациядан кейінгі геморрагиялық проктитпен ауыратын екі пациентке Pulse 15wt режимінде коагуляция және аргон ағыны 0,4-1,0 л/мин. геморрагиясы бар GAVE синдромы бар пациентке 35wt режимінде 2 АПК сессиясы өткізілді, газ ағыны 0,8 л/мин. негізгі бронх тігісі фистулалары бар 3 пациентте пульмонэктомиядан кейін коагуляция жүргізілді және фистуланьң жабылуы байқалды 1 апта ішінде. Эзофагоэнтероанастомоздың дәрменсіздігі бар екі пациентке 5 күн аралықпен 40 ватт аргонды пайдалана отырып, 2 АПК сеансы өткізілді. Науқаста тік ішектің алдыңғы резекциясынан кейін көп камералы қуысы бар анастомоздың сәтсіздігі және іріңді құрамы болды. АПК-нің 4 курсы 2 апта аралықпен өткізілді, АПК-тен кейін негізгі камераның сағасы тарылды, іріңнің бөлінуі тоқтады, нәтижесінде қосымша камераларсыз және қабыну белгілерінсіз 2,0 см-ге дейін соқыр қалта қалды.

Қорытынды: Мақалада онкологиялық клиникада әртүрлі патологиялары бар пациенттерді емдеу әдісі ретінде АПК енгізу нәтижелері ұсынылған және осы нәтижелер негізінде АПК бүкіл Қазақстан бойынша кеңінен енгізу үшін ұсынылуы мүмкін.

Түйінді сөздер: аргоноплазмалық коагуляция (АПК), Барреттің өңеші, эндоскопия, неоплазмалар, анастомоздың сәтсіздігі.

АННОТАЦИЯ

ПРИМЕНЕНИЕ АРГОНОПЛАЗМЕННОЙ КОАГУЛЯЦИИ В ЭНДОСКОПИИ

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Актуальность: Аргоноплазменная коагуляция (АПК) – малоинвазивный бесконтактный метод электрохирургии. Эту процедуру выполняют при следующих состояниях: кровотечения в полых органах, в том числе при изъязвлении после лучевой терапии, пищевод Барретта, при прорастании злокачественной опухоли через стент, доброкачественные новообразования, предраковые состояния, некоторые злокачественные опухоли на самых ранних стадиях. В этой статье авторы представляют первый и успешный опыт применения АПК в Казахстане при эндоскопических вмешательствах у пациентов с различной патологией.

Цель исследования – оценка эффективности внедрения АПК в качестве эндоскопического лечения у пациентов с предраковой патологией и осложнениями хирургического лечения у онкологических пациентов.

Методы: Проведен ретроспективный анализ применения и эффективности АПК у 15 пациентов с различной патологией, находившихся на стационарном лечении в Национальном научном онкологическом центре (ННОЦ, Астана, Казахстан) в течение 2022 года.

Результаты: В стационаре ННОЦ успешно проведена АПК пищевода Барретта 6 пациентам, при контроле в биопсийном материале не выявлены признаки метаплазии эпителия пищевода по кишечному типу. Двум пациентам с постлучевым геморрагическим проктитом выполнена коагуляция в режиме Pulse 15Wt и потоке аргона 0,4-1,0 л/мин. Пациенту с GAVE-синдромом с геморрагиями проведено 2 сеанса АПК в режиме 35Wt с потоком газа 0,8 л/мин. У 3-х пациентов со свищами шва главного бронха после пульмонэктомии проведена коагуляция и закрытие свища наблюдалось в течение 1 недели. Двум пациентам с несостоятельностью эзофагоэнтjeroанастомоза проведено 2 сеанса АПК с использованием 40-ваттного аргона с интервалом по 5 дней. У пациента после передней резекции прямой кишки имелась несостоятельность анастомоза с многокамерной полостью и наличием гнойного содержимого. Проведено 4 курса АПК с интервалом в 2 недели, после АПК устье главной камеры сузилось, прекратилось выделение гноя, в итоге остался слепой карман до 2,0 см без дополнительных камер и признаков воспаления.

Заключение: В статье представлены результаты внедрения АПК как метода лечения пациентов с различными патологиями в онкологической клинике и на основании этих результатов АПК можно рекомендовать для широкого внедрения по всему Казахстану.

Ключевые слова: аргоноплазменная коагуляция (АПК), пищевод Барретта, эндоскопия, новообразования, несостоятельность анастомоза.

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