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CLINICAL AND MORPHOLOGICAL EVALUATION OF THE EFFECTIVENESS OF USING RADIO WAVE AND HIGH-FREQUENCY ELECTROSURGERY TECHNOLOGIES FOR THE TREATMENT OF COMBINED ANORECTAL DISEASES

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Nowadays, the number of proctological diseases is significantly increasing, among which the share of combined anorectal pathology reaches from 35 to 65 %. The results of surgical treatment of 635 patients with combined anorectal diseases who were divided into 4 research groups have been shown. After operations, 30 patients in each group underwent morphological investigations of the anal canal and rectal tissues to study the depth of coagulation necrosis. In the case of using the high-frequency electrosurgical device with a frequency of 330 kHz was formed layer of coagulation necrosis with a thickness of 0.302±0.107 mm, in the case of using a high-frequency electrosurgical device with frequency 375 KHz – 0.208±0.097 mm, in case of using a high-frequency electrosurgical device with frequency 450 KHz – 0.194±0.090 mm and in case of using the radio-wave device with frequency 3.8–4.0 MHz – 0.189±0.085 mm. Using these technologies reduces the operation duration, volume of bleeding, and intensity of the postoperative pain and prevents the formation of anal strictures.

Key words: radio-wave surgery device, high-frequency electrosurgery devices, combined anorectal diseases.

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КЛІНІЧНА ТА МОРФОЛОГІЧНА ОЦІНКА ЕФЕКТИВНОСТІ ВИКОРИСТАННЯ СУЧАСНИХ РАДІОХВИЛЬОВИХ ТА ВИСОКОЧАСТОТНИХ ЕЛЕКТРОХІРУРГІЧНИХ ТЕХНОЛОГІЙ ДЛЯ ЛІКУВАННЯ КОМБІНОВАНИХ АНОРЕКТАЛЬНИХ ЗАХВОРЮВАНЬ

Сьогодні значно зростає кількість проктологічних захворювань, серед яких частка поєднаної аноректальної патології сягає від 35 до 65 %. Наведено результати хірургічного лікування 635 хворих на поєднані аноректальні захворювання, які були розподілені на 4 дослідницькі групи. Після операцій 30 пацієнтів з кожної групи підлягали морфологічному дослідженню тканин анального каналу та прямої кишки для вивчення глибини коагуляційного некрозу. При використанні високочастотного електрохірургічного апарату з частотою 330 КГц утворювався шар коагуляційного некрозу товщиною 0,302±0,107 мм, при використанні високочастотного електрохірургічного апарату з частотою 375 КГц – 0,208±0,097 мм, у разі використання високочастотного електрохірургічного апарату з частотою 450 КГц – 0,194±0,090 мм та при використанні апарату радіохвильової хірургії з частотою 3,8–4,0 МГц – 0.189±0,085 мм. Використання цих технологій зменшує тривалість операції, об'єм кровотечі, інтенсивність післяопераційного болю та запобігає утворенню анальних стриктур.

Ключові слова: апарат радіохвильової хірургії, апарати високочастотної електрохірургії, комбіновані аноректальні захворювання.

The work is a fragment of the research project "Improvement of diagnostic, treatment and rehabilitation of patients with the abdominal cavity, anterior abdominal wall and perineum diseases", state registration No. 0121U108118.

At the present stage of the development of society, the number of proctological diseases is significantly increasing, among which the share of combined pathology of the anal canal and rectum is growing rapidly, ranging from 35 to 65 %. The most common is a combination of the following proctological diseases: hemorrhoids and anal fissure – 21.6–60.7 %, hemorrhoids and anal fistula – 9.5–27.7 %, hemorrhoids and anal polyp – 8.5–17.7 %, hemorrhoids, anal fissure and anal polyp – 1.1–7.3 %, hemorrhoids, anal fissure and anal fistula – 1.7–7.5 % [1].

The progressive development of modern surgical technologies has contributed to the active introduction into coloproctological practice of new high-tech methods of surgical treatment of various pathologies of the anal canal and rectum [13].

Over the last decade, "hybrid" surgeries have been widely used in the treatment of III–IV stages chronic hemorrhoids in combination with other pathologies of the anal canal and rectum. They include a combination of dearterialization of hemorrhoids with mucopexy (HAL – RAR, THD) or latex ligation of hemorrhoids, their lifting and mucopexy with the removal of concomitant pathology of the anal canal [3, 5, 12]. These surgeries significantly improve the immediate and long-term anatomical and functional results of surgical treatment of both hemorrhoids and concomitant anorectal pathology. Especially, in cases of transsphincteric and extrasphincteric fistulas, but unfortunately, they also have drawbacks [2, 6, 7]. Among the complications of such operations are the following: thrombosis of external hemorrhoid (6.25–14.6 %),

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perianal edema (18–34 %), acute anal fissure (2 %), postoperative bleeding (3.12–13.8 %), prolapse of hemorrhoids (7.2–18 %), the formation of hypertrophied perianal skin tags (26.4–75 %) [2, 10, 12].

Thus, Valleylab (USA) has developed a bipolar electro-thermal system "Liga Sure" for coagulation and cross-section of blood vessels larger than 7 mm in diameter, which provides controlled energy supply to tissues and reliable hemostasis, which has been actively used in modern coloproctology for surgical treatment of hemorrhoids. The depth of thermal impact on the tissues when using this system is 2 mm [4]. However, unfortunately, this technique has a number of disadvantages: intense pain (11.7 %), recurrence of diseases (7.5 %), postoperative bleeding (2.1–7.1 %), and anal stricture (2.1–2.8 %) [4, 11, 14].

The ultrasonic harmonic scalpel "Ultra Cision" from Ethicon Endo-Surgery (USA) has become widely used in coloproctology. As a result, there is a coagulation of the lumen of blood vessels up to 5 mm in diameter and the depth of thermal impact on the tissues does not exceed 1.5 mm. These properties make it possible to perform surgery without vascular stitching with minimal thermal exposure to the tissues of the anal canal, which reduces the duration of the operation [8]. However, this method is accompanied by the occurrence of postoperative bleeding (1.8–7.2 %), severe pain (6.4–9.2 %), urinary disorders (12 %), tenesmus (8 %), prolonged healing of postoperative wounds (10 %) and disease recurrence (7.8 %) [8, 9].

Thus, the problem of the urgency of combined pathology of the anal canal and rectum is quite high. It contributes to the creation and implementation of modern minimally invasive and highly effective methods of surgical treatment of this pathology in the practice of coloproctologists, which would have minimal tissue damage, ensure no complications and recurrences, reduced the duration of inpatient treatment of patients and would promote their rapid medical and social rehabilitation.

The purpose of the study was to perform a comparative evaluation of the effectiveness of high-frequency electrosurgical devices, as well as radio-wave surgery devices in the treatment of patients with combined pathology of the anal canal and rectum.

Materials and methods. In the period from January 2007 to March 2020, we operated on 635 patients with combined pathology of the anal canal and rectum using high-frequency electrosurgical devices "ERBE ICC 200" (Germany), "EFA" (Russian Federation), "KLS Martin" (Germany), as well as radio-frequency device "Surgitron" (USA). Of these, 358 (56.4 %) patients were male and 277 patients (43.6 %) were female. The age of patients ranged from 18 to 76 years.

The first study group consisted of 169 patients with combined pathology of the anal canal and rectum, who were operated on using a high-frequency electro surgery device "ERBE ICC 200" for the period from March 2008 to February 2019. Of these, 104 (61.5 %) patients were male and 65 (38.5 %) were female. The age of patients ranged from 20 to 76 years. The second study group consisted of 114 patients with combined pathology of the anal canal and rectum, who were operated on using a high-frequency electrosurgical device "EFA" for the period from January 2007 to February 2019. Of these, 65 (57 %) patients were male and 49 (43 %) were female. The age of patients ranged from 24 to 72 years. The third study group consisted of 107 patients with combined pathology of the anal canal and rectum, who were operated on using a high-frequency electrosurgical device "KLS Martin" for the period from October 2017 to February 2020. Of these, 43 (40.2 %) patients were male and 64 patients (59.8 %) were female. The age of patients ranged from 19 to 65 years. The fourth study group consisted of 245 patients with combined pathology of the anal canal and rectum, who were operated on using the radio-wave surgery device "Surgitron" for the period from September 2009 to February 2019. Of these, 143 (58.4 %) patients were male and 102 (41.6 %) were female. The age of patients ranged from 18 to 74 years.

All 635 patients, who were divided into 4 study groups, signed a voluntary informed consent for anesthesia and surgery, which were performed under spinal anesthesia.

The control group consisted of 112 patients with combined pathology of the anal canal and rectum, who were operated on with a metal scalpel.

After surgery using high-frequency electro-surgery devices "ERBE ICC 200", "EFA", "KLS Martin", as well as radio-wave surgery device "Surgitron" 30 patients from each study group underwent morphological examination of the anal canal and rectal tissues for measurement of the thickness of coagulation necrosis, which was performed, using an eyepiece-micrometre scale.

Statistical analysis of the obtained data was performed using SPSS software. The normality check was performed using the Shapiro-Wilk test. The equality of variances was checked using Levene's test. The critical level of statistical significance was 0.05. For normally distributed variables with equal variances in groups one-way analysis of variance was used to compare all groups and the Bonferroni test was used for pair groups comparison and with not equal variances in groups the Welch test and the Brown-Forsyth test were used for comparison of all groups and the Games-Howell test was used for pair groups comparison. For non-normally distributed variables with equal variances in groups, the Kruskal-Wallis test

was used for all groups' comparison and the Mann-Whitney test was used for pair groups' comparison. The statistical significance of differences between groups was calculated for groups with a sample size of 30 patients for each operative method.

Results of the study and their discussion. Comparative characteristics of high-frequency electrosurgical devices "ERBE ICC 200", "EFA" and "KLS Martin", the device of radio-wave surgery "Surgitron", as well as a metal surgical scalpel in the surgical treatment of patients with combined pathology of the anal canal and rectum are shown in Table 1, where the indicators are presented in the form of M±SD.

Table 1

Comparative characteristics of using modern and traditional surgical technologies for treatment of the combined pathology of the anal canal and rectum (M±SD)

Comparison criteria	"Surgitron" (n=30)	"ERBE" ICC 200 (n=30)	"EFA" (n=30)	"KLS Martin" (n=30)	Metal surgical scalpel (n=30)
Duration of operation (minutes)**[1]	15±3*	20±3*	25±3*	15±3*	30±3*
Volume of blood loss (ml)**[2]	20±6*	15±6*	20±3*	20±6*	40±6*
The severity of the pain syndrome (need for narcotic analgesics, ml)**[3]	2±1*	3±1*	2±1*	2±1*	4±1*
Duration of inpatient treatment (days)**[3]	4±1*	6±1*	5±1*	4±1*	7±1*
Depth of coagulation necrosis layer (mm)**[3]	0.189±0.085*	0.302±0.107*	0.208±0.097*	0.194±0.090*	-

Note: * M±SD, where M is the arithmetic mean, S is the standard deviation (95 % from D mean); **statistically significant difference between groups p <0.001; [1]one-way analysis of variance; [2]Welch test and the Brown-Forsyth test; [3]Kruskel-Wallis test.

Comparison of groups revealed a statistically significant difference with a significance level of p<0.001 for all indices.

Statistical analysis was performed to determine the statistical significance of differences between groups for which different operating methods were used. Using Shapiro-Wilk and Levene's tests, the normal distribution of variables in groups and equality of variances were established; based on the results obtained, a method was chosen to test for differences between groups. The statistical significance of the differences between pairs of groups is presented in Table 2.

Table 2

Statistical significance of differences between pairs of groups

Comparable groups		Duration of operation[1]	Volume of blood loss[2]	The severity of the pain syndrome[3]	Duration of inpatient treatment[3]	Depth of coagulation necrosis layer[3]
"Surgitron"	"ERBE"	<0.001*	0.003*	<0.001*	<0.001*	<0.001*
"Surgitron"	"EFA"	<0.001*	0.011	<0.001*	<0.001*	0.002*
"Surgitron"	"KLS Martin"	<0.001*	0.011	<0.001*	<0.001*	<0.001*
"Surgitron"	Metal surgical scalpel	<0.001*	<0.001*	<0.001*	<0.001*	
"ERBE"	"EFA"	<0.001*	1	1.000	<0.001*	0.464
"ERBE"	"KLS Martin"	<0.001*	1	0.268	<0.001*	0.773
"ERBE"	Metal surgical scalpel	<0.001*	<0.001*	<0.001*	<0.001*	
"EFA"	"KLS Martin"	1	1	0.268	0.447	0.271
"EFA"	Metal surgical scalpel	<0.001*	<0.001*	<0.001*	<0.001*	
"KLS Martin"	Metal surgical scalpel	<0.001*	<0.001*	<0.001*	<0.001*	

Note: *statistically significant difference between groups; [1]Bonferroni test; [2]Games-Howell test; [3]Mann-Whitney test.

Comparing every study group with the control group showed statistically significant differences for all indices.

In the morphological study, it was found that when using the device of high-frequency electro-surgery "ERBE ICC 200" patients of the first study group, the tissue incision was due to their dissection and coagulation with hemostasis control and the formation of a thin layer of coagulation necrosis, the average thickness of which was 0.302±0.107 mm (fig. 1).

During the morphological examination of tissues after the use of the high-frequency electrosurgical device "EFA" in patients of the second study group, it was found that a thinner layer than in the first group of coagulation necrosis was formed, the average thickness of which was 0.208±0.097mm (fig. 2).

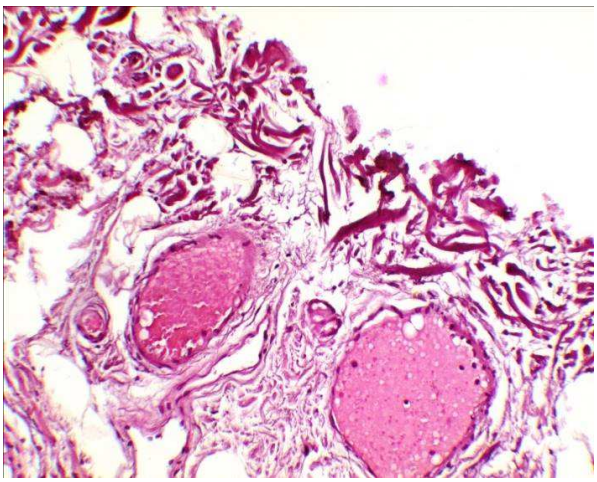

Fig. 1. The edge of the incision with a device of high-frequency electro-surgery "ERBE ICC 200" – preservation of the tissue structure with the formation along the edge of the incision of a thin layer of coagulation necrosis. Staining with hematoxylin-eosin. Magnification x 100.

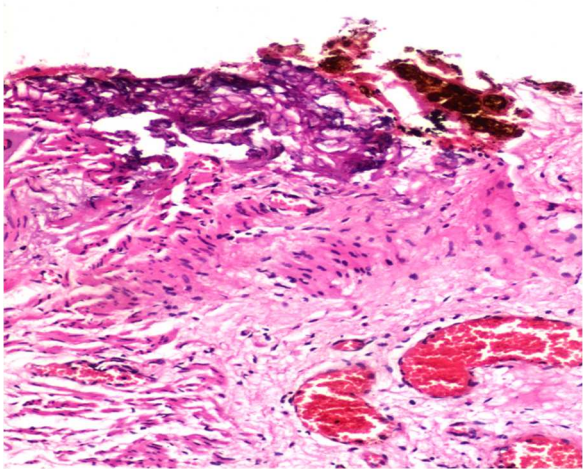

Fig. 2. The edge of the incision by the device of high-frequency electrosurgery "EFA" – preservation of the tissue structure with the formation of a thin layer of coagulation necrosis along the edge of the incision. Staining with hematoxylin-eosin. Magnification x 100.

When using a high-frequency electrosurgical device "KLS Martin" in patients of the third study group, we observed the preservation of tissue structure with the formation of the edge of the incision even thinner layer of coagulation necrosis than in the second group with a thickness of 0.194±0.090 mm. There were full blood vessels, and in isolated cases, small hemorrhages took place (fig. 3.)

The use of the "Surgitron" radio-wave device in patients of the fourth study group contributed to the preservation of tissue structure with the formation of the thinnest layer of coagulation necrosis along the edge of the incision among all study groups, the average depth of which was 0.189±0.085mm (fig. 4).

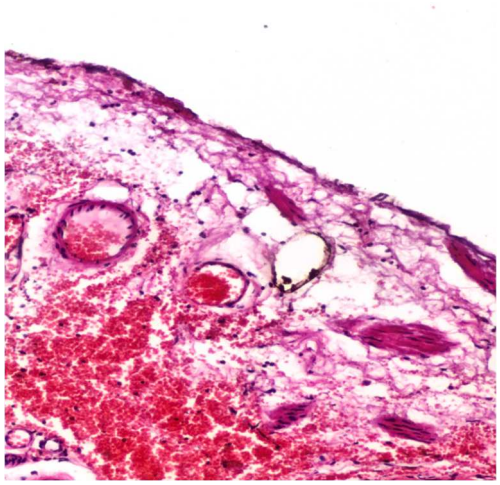

Fig. 3. The edge of the incision with a high-frequency electrosurgical device "KLS Martin" – preservation of tissue structure with the formation of a thin layer of coagulation necrosis along the edge of the incision. Staining with hematoxylin-eosin. Magnification x 100.

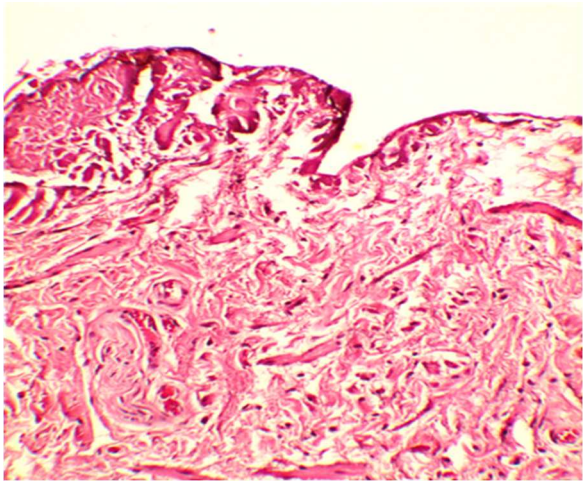

Fig. 4. Edge of the incision after using the radio-wave surgery "Surgitron" – preservation of the tissue structure by creating a thin layer of coagulation necrosis along the edge of the incision. Staining with hematoxylin-eosin. Magnification x100.

Using of the radiosurgical device "Surgitron" and the high-frequency electrosurgical device "KLS Martin" causes approximately the same, the smallest among all devices, depth of coagulation necrosis of tissues which makes at radiofrequency influence 0.189±0.085 mm and at electrosurgical – 0.194±0.09 mm, which is followed the shortest duration of operations, insignificant volume of blood loss, the least expressed postoperative pain syndrome and the shortest terms of inpatient treatment, which coincides with the data of other authors [15].

Application of the high-frequency electro-surgery device "EFA" was accompanied by a greater depth of coagulation tissue necrosis, which was 0.208±0.097 mm and was accompanied by a longer average duration of operations and a longer period of inpatient treatment. Using of the high-frequency electro-surgery device "ERBE ICC 200" was accompanied by the lowest volume of blood loss among all study groups, but the depth of coagulation necrosis was the largest, amounting to 0.302±0.107 mm, which was accompanied by the most severe pain in the postoperative period and the longest period of inpatient treatment.

Due to the minimal and insignificant impact on the tissues when using the "Surgitron" radio-surgery device, as well as the "KLS Martin", "EFA" and "ERBE ICC 200" high-frequency electro-surgery devices, neither scar strictures of the anal canal nor scarring deformities of the pararectal areas were detected in any of the four study groups, that indicates better results than in case of using "Liga Sure" surgery [4, 14], which contributed to the cosmetic nature of the combined operations and caused rapid rehabilitation of patients in the study groups, while in the control group in 2 (2 %) patients revealed the formation of scarring stricture of the anal canal, which required conservative (1 patient) and operative (1 patient) measures to eliminate them. Moreover, using all these high-frequency electro-surgery technologies is accompanied by the formation of a thin layer of coagulation tissue necrosis with a depth of 0.053 to 0.457 mm, which is better than using "Ultra Cision" and "Liga Sure" with thermal necrosis from 1.5 to 2 mm [4, 8].

Conclusions

1. Using of radio-wave surgery device "Surgitron" and high-frequency electrosurgery devices "ERBE ICC 200", "EFA", "KLS Martin" for the treatment of combined anorectal diseases, due to the shallow tissue effects, helps to reduce the duration of surgery, the volume of bleeding, and pain syndrome after operations and stipulates fast patients' medical rehabilitation.

2. Application of these modern devices of high-frequency electrosurgery and radio-wave surgery is much better compared to using a surgical metal scalpel because they cause much less pain due to the formation of a thin layer of coagulation necrosis, promoting the formation of a delicate elastic scar and preventing the occurrence of scar anal strictures in the postoperative period.

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