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INFLUENCE OF A VARIETY OF SUTURE MATERIAL ON THE ANAL CANAL WOUNDS HEALING AFTER COMBINED OPERATIONS CONCERNING THE COMBINED ANORECTAL PATHOLOGY WITH USING OF MODERN TECHNOLOGIES

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Abstract.

The urgency of the problem of combined pathology of the anal canal and rectum is quite high due to the lack of a unified approach to surgical treatment of this category of patients.

The aim of the study was to conduct a comparative morphological assessment of postoperative wound healing in patients with combined anorectal pathology after combined operations using different types of suture material, as well as modern high-frequency electrosurgery and radio-wave surgery devices.

The dynamics of the wound process under the influence of Caprosyn (3/0) and Polysorb (3/0) was performed on 60 patients from the first and second study groups, where radio-frequency device "Surgitron" and high-frequency electrosurgery device "KLS Martin" were used for surgical treatment, as they had approximately the same depth of coagulation tissue necrosis, by cytological examination of smears-imprints from the surface of postoperative wounds on 3, 5, 7, 14 and 21 days.

Despite all differences in the early stages of wound healing between groups of patients using two different types of suture material, the formation of scar connective tissue occurred almost equally on 14-17 days with the formation of bundles of collagen fibers with cellular elements between them. Epithelialization processes, which were characterized by the appearance of cells of mature multilayered squamous epithelium, in two groups of patients using suture material Caprosyn (3/0) and Polysorb (3/0) also occurred simultaneously on 19-22 days.

Using of radio-wave surgery device "Surgitron" and high-frequency electrosurgery device "KLS Martin" and suture material Caprosyn (3/0) and Polysorb (3/0) was not accompanied by complications such as bleeding, suppuration of postoperative wounds, anal strictures, and recurrence of diseases.

Key words. Wound healing, morphological assessment, suture material, combined anorectal pathology, radio –wave surgery and high – frequency electrosurgery technologies.

Introduction.

The urgency of the problem of combined pathology of the anal canal and rectum is quite high due to the lack of a unified approach to surgical treatment of this category of patients. Moreover, a rather small number of publications with the results of scientific research are devoted to the study of this problem [1]. Scar strictures of the anal canal, insufficiency of the anal sphincter, as well as deformities of the perianal area and perineum are often found among the complications after combined operations on the anal canal and rectum due to their combined pathology [2].

The main method of surgical treatment of the most common proctological diseases - hemorrhoids, anal fissures and fistulas remains traditional instrumental surgery, but it is often accompanied by severe postoperative pain and prolonged healing of postoperative wounds, which, according to some authors, is directly related to surgical trauma in the rich innervation zone of the anal canal, causing local edema, acute subclinical infection, and inflammation [3,4]. According to other authors, postoperative pain, and ischemic changes in tissues with their subsequent suppuration and delayed epithelialization occur due to compression of smooth muscle fibers of the internal sphincter and mucous membrane in the area of stitching with the development of subsequent tissue reaction to suture material, which is most common after closed hemorrhoidectomy [5,6].

The effect of suture on the healing of wounds of the anal canal and rectum in the postoperative period showed that using of sutures coated with triclosan reduced the incidence of infections in the surgical area to 6.9% compared with patients who used suture without this antibacterial coating in which the frequency of suppuration of wounds was 9.1-19.2% [7-9].

Ratto C. and co-authors proved the feasibility of using a continuous vicryl seam, and Yu JH. and co-authors of a large C-shaped suture for suturing the prolapsed mucosa and submucosal layers of the rectum, as an adjunct to the THD procedure for mucopexy in patients with chronic hemorrhoids. But unfortunately, these techniques are accompanied by bleeding, tenesmus, sometimes anal incontinence and recurrence of the disease [10,11].

The active development of high-tech methods of surgical treatment of diseases of the anal canal and rectum has reduced the trauma and duration of surgery, as well as the depth of thermal exposure to tissues. These techniques allow not to use suture material, which has a pronounced tissue reaction and purulent-inflammatory complications. Thus, Valleylab (USA) has developed a bipolar electrothermal system "Liga Sure" for surgical treatment of hemorrhoids [12,13]. Using this device there is no need to isolate and treat the vascular leg of the hemorrhoid, so this method of hemorrhoidectomy is called "closed sutureless hemorrhoidectomy" [12]. However, the depth of thermal exposure to tissues when using this system is from 1.5 to 2 mm, which is often accompanied by suppuration of postoperative wounds (2-15%), as well as the occurrence of strictures of the anal canal (2-9%) [13,14].

Thus, the urgency of the problem of postoperative wound healing after combined operations for combined anorectal pathology is quite high and contributes to the introduction of new modern surgical technologies and types of suture material

for the treatment of this pathology, which would have minimal damage to tissues, preventing occurrence of their inflammatory reaction and suppuration of postoperative wounds, promoting their rapid healing and causing faster medical and social rehabilitation of patients.

The aim of the study was to conduct a comparative morphological assessment of postoperative wound healing in patients with combined anorectal pathology after combined operations using different types of suture material, as well as modern devices for high frequency electrosurgery and radiosurgery.

Materials and methods.

In the period from January 2007 to June 2021, 405 patients with combined diseases of the anal canal and rectum were operated on in the proctology department of Public Non-Profit Enterprise “Khmel`nyts`kyi regional hospital” under Khmel`nyts`ky Regional Council using the radio-wave surgery device “Surgitron” and the high-frequency electrosurgery device “KLS Martin”. Among them 224 (55.4%) patients were male and 181 (44.6%) were female. The age of patients ranged from 18 to 74 years.

All 405 patients, who were divided into 2 study groups, signed a voluntary informed consent for anesthesia and surgery, which were performed under spinal anesthesia. Of these, 215 (53,1%) patients were operated with resorbable monofilament synthetic suture Caprosyn (3/0) and 190 (46,9%) patients were operated with resorbable polyfilament synthetic suture Polysorb (3/0).

The first study group consisted of 245 patients with combined pathology of the anal canal and rectum, who were operated using a radio-wave surgery device "Surgitron". Of these, 143 (58.4%) patients were male and 102 (41.6%) were female. The age of patients ranged from 18 to 74 years.

The second study group consisted of 160 patients with combined pathology of the anal canal and rectum, who were operated using a high frequency electrosurgery device "KLS Martin". Of these, 64 (40%) patients were male, and 96 patients (60%) were female. The age of patients ranged from 19 to 65 years.

The dynamics of the wound process under the influence of Caprosyn (3/0) and Polysorb (3/0) was assessed by cytological examination of smears-imprints from the surface of postoperative wounds on 3, 5, 7, 14 and 21 days. For this action were used cytological brushes, with which the substrate was applied to slides. The material was fixed for 1 minute in a dye-fixative solution of May-Grunwald, then painted for 17 minutes with a solution of paint according to Romanovsky, washed with water and dried. Microscopy was performed with dry and immersion systems.

The cytological study was performed on 60 patients from the first and second study groups, where radio-frequency device “Surgitron” and high-frequency electrosurgery device “KLS Martin” were used for surgical treatment, as they had approximately the same depth of coagulation tissue necrosis [15]. Both of these groups were divided into two subgroups (30 patients each), in which Caprosyn (3/0) and Polysorb (3/0) were used as sutures for surgery. The severity and duration of the inflammatory reaction in the wound was assessed by the number of neutrophils, the presence of dystrophic changes, the presence of macrophages. The timing of reparative signs was assessed by the appearance of cells such as histiocytes, fibroblasts, fibrocytes, as well as connective tissue fibers and squamous epithelial cells.

Statistical analysis of the obtained data was performed using IBM SPSS STATISTICS SUBSCRIPTIONAL TRIAL software. License number: L-CZAA-BHG85V. The statistical significance of the median difference was calculated using the Mann-Whitney test. The sample size was 30 people in each group, a total of 120 patients. The critical level of statistical significance was 0.05. Descriptive statistics of inpatient treatment duration and wound healing time were performed using the following indicators: 25th, 50th, 75th percentiles.

Results and Discussion.

As a result of pairwise comparison between subgroups using Caprosyn (3/0) and Polysorb (3/0) as a suture material according to the Mann-Whitney test in the first study group, where the radio-wave surgery device "Surgitron" was used for surgical treatment, a statistically significant difference between the two subgroups was found in such criteria as a neutrophil duration, histocyte and fibroblast appearance, while according to the other two criteria (formation of collagen fibers and the appearance of cells of the multilayered squamous epithelium), there was no statistically significant difference between these two subgroups, as shown in Table 1.

Table 1. *Comparison between subgroups using Caprosyn (3/0) and Polysorb (3/0) as a suture material in the first study group, where the radio-wave surgery device "Surgitron" was used.*

Criterion	Suture material	Percentiles			Statistical significance of median differences, p (according to the Mann-Whitney test)
		25	50	75	
Duration of neutrophil reaction	Caprosyn	3	4	5	0,001*
	Polysorb	4	5	5	
Appearance of histiocytes	Caprosyn	5	5	6	<0,001*
	Polysorb	6	6	6,25	
Appearance of fibroblasts	Caprosyn	7	7	7	<0,001*
	Polysorb	7	8	9	
Formation of collagen fibers	Caprosyn	14	15	15	,191
	Polysorb	14	15	15,25	
Appearance of the stratified squamous epithelium cells	Caprosyn	19	20	20	,509
	Polysorb	19	20	20	

*Note: * statistically significant differences.*

Comparison between subgroups using Caprosyn (3/0) and Polysorb (3/0) as a suture material according to the Mann-Whitney test in the second study group, where the high-frequency electrosurgery device “KLS Martin” was used for surgical treatment, a statistically significant difference between the two subgroups also was found in such criteria as a neutrophil duration, histocyte and fibroblast appearance, while according to the other two criteria (formation of collagen fibers and the appearance of cells of the multilayered squamous epithelium), there was no also statistically significant difference between these two subgroups, which is shown in Table 2.

Table 2. *Comparison between subgroups using Caprosyn (3/0) and Polysorb (3/0) as a suture material in the forth study group, where the high frequency electrosurgery device "KLS Martin" was used.*

Criterion	Suture material	Percentiles			Statistical significance of median differences, p (according to the Mann-Whitney test)
		25	50	75	
Duration of neutrophil reaction	Caprosyn	4	5	5	0,007*
	Polysorb	5	5	6	
Appearance of histiocytes	Caprosyn	6	6	7	<0,001*
	Polysorb	7	7	8	
Appearance of fibroblasts	Caprosyn	8	8	9	<0,001*
	Polysorb	9	9	10	
Formation of collagen fibers	Caprosyn	15	16	17	,522
	Polysorb	15	16	17	
Appearance of the stratified squamous epithelium cells	Caprosyn	20	21	22	,805
	Polysorb	20	21	22	

*Note: * statistically significant differences.*

On the 3rd day after surgery in cytological examination of smears from the surface of postoperative wounds more pronounced neutrophilic reaction was observed in groups of patients using high frequency electrosurgery device "KLS Martin" and radio wave surgery device "Surgitron" using as suture material Polysorb (3/0) in compared with the groups where the suture material Caprosyn (3/0) was used (Figures 1 and 2).

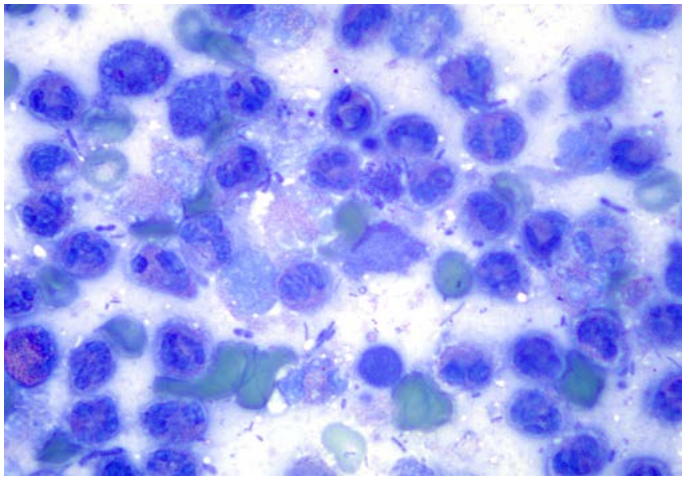

Figure 1. *Cytogram of smears from the wound surface for 3 days after surgery using high-frequency electrosurgery device "KLS Martin" and suture material Polysorb (3/0) - a large number of elements of neutrophilic inflammation, the phenomenon of incomplete phagocytosis. Stained by Romanovsky. Magnification x1000.*

During the analysis of smears from postoperative wounds on the 5th day in groups of patients using high-frequency electrosurgery device "KLS Martin" and radio-wave surgery device "Surgitron" and suture material Caprosyn (3/0) observed the appearance of mononuclear histiocytes (Figure 3), while using suture material Polysorb (3/0), histiocytes appeared on day 7 (Figure 4).

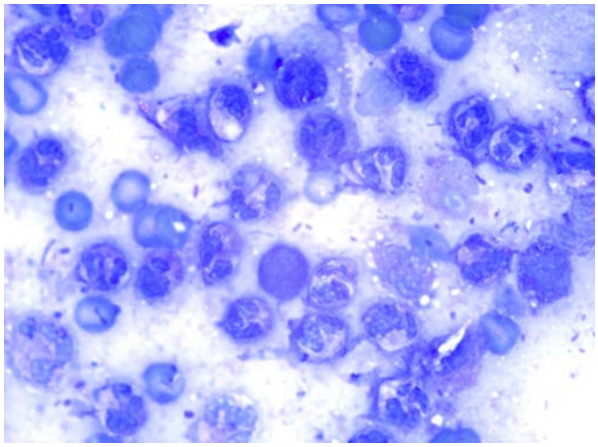

Figure 2. *Cytogram of smears from the wound surface for 3 days after surgery using the radio-wave surgery device "Surgitron" and suture material Caprosyn (3/0) - the presence of segmental neutrophils, the phenomenon of incomplete phagocytosis. Stained by Romanovsky. Magnification x1000.*

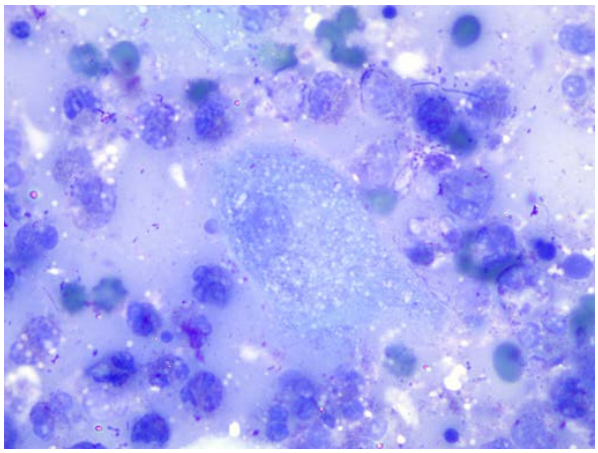

Figure 3. *Cytogram of smears from the wound surface on the 5th day after surgery using the device of high-frequency electrosurgery "KLS Martin" and suture material Caprosyn (3/0) - the appearance of histiocytes. Stained by Romanovsky. Magnification x1000.*

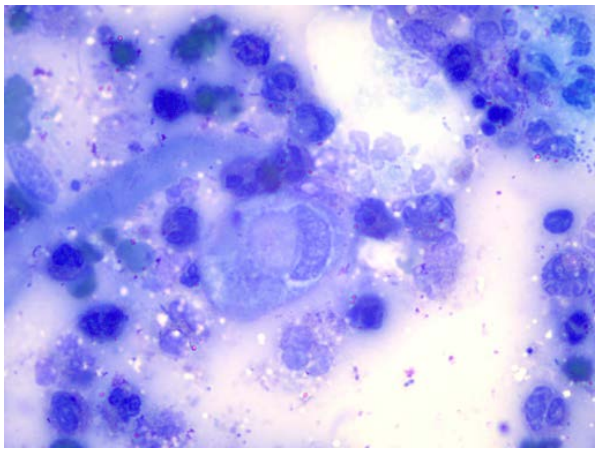

Figure 4. *Cytogram of smears from the wound surface on the 5th day after surgery using the radio-wave surgery device "Surgitron" and as a suture material Polysorb (3/0) - the appearance of histiocytes. Stained by Romanovsky. Magnification x1000.*

On day 7, most patients in the Caprosyn (3/0) suture groups developed fibroblasts and loose connective tissue fibers, indicating the appearance of granulation tissue as a sign of reparative changes (Figures 5 and 6).

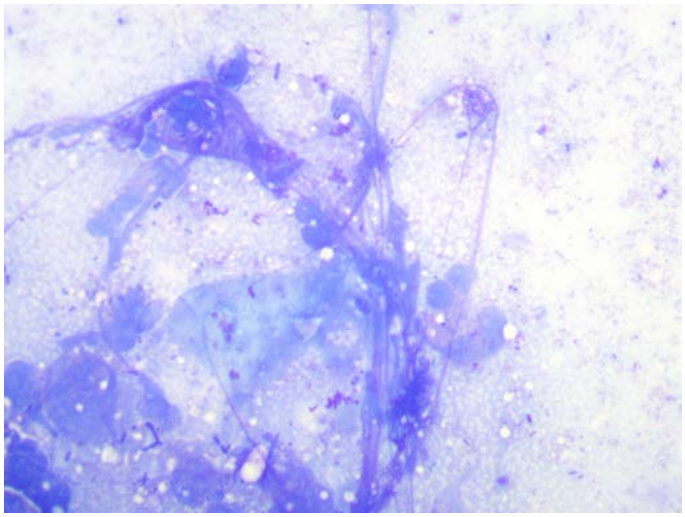

Figure 5. *Cytogram of smears from the surface of the wound on the 7th day after surgery using the device of radio-wave surgery "Surgitron" and suture material Caprosyn (3/0) - the appearance of fibroblasts and single connective tissue fibers. Stained by Romanovsky. Magnification x1000.*

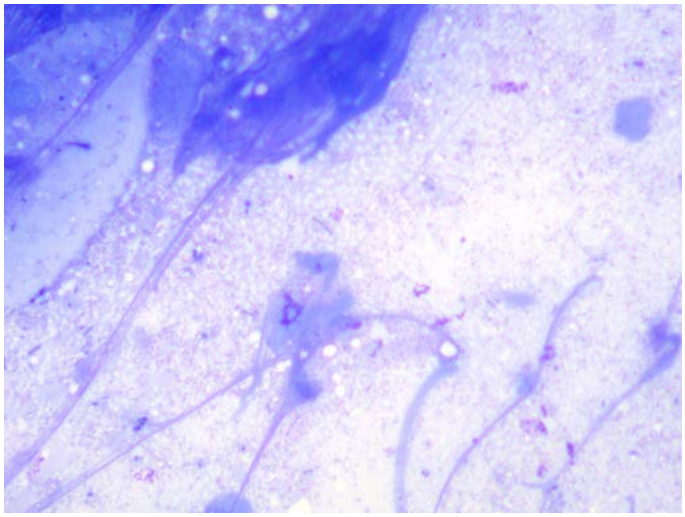

Figure 6. *Cytogram of smears from the wound surface on the 7th day after surgery using of high-frequency electrosurgery device "KLS Martin" and suture material Caprosyn (3/0) - single fibroblasts that synthesize connective tissue fibers. Stained by Romanovsky. Magnification x1000.*

On the 14th day of the postoperative period, all studied groups of connective tissue fibers form bundles, in places with the presence of cellular elements between the fibers (Figures 7 and 8).

It is noted that in most patients during this period of wound healing almost disappears inflammatory infiltration. It remains only in isolated cases in patients where Polysorb (3/0) was used as suture material (Figure 9).

It was also found that in groups of patients using suture material Polysorb (3/0) bundles of fibers with cellular elements were thicker than in groups using suture material Caprosyn (3/0), and fibroblasts with processes were found, which indicated the beginning of the formation of scar connective tissue (Figures 10 and 11).

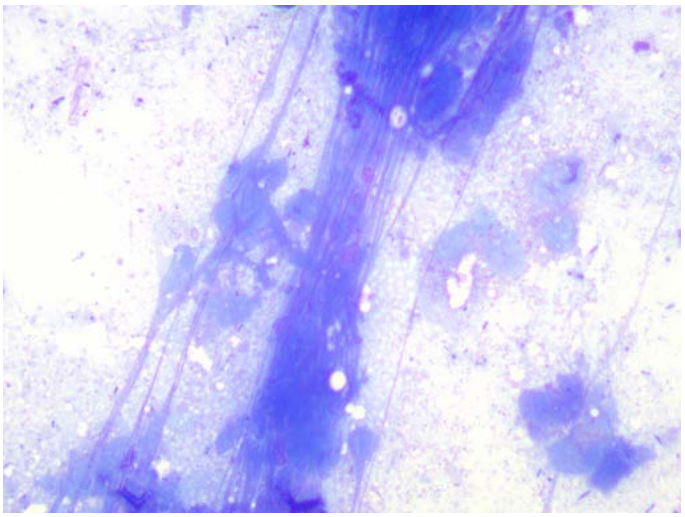

Figure 7. *Cytogram of smears from the wound surface on the 14th day after surgery using of radio-wave surgery device "Surgitron" and suture material Caprosyn (3/0) - connective tissue fibers. Stained by Romanovsky. Magnification x1000.*

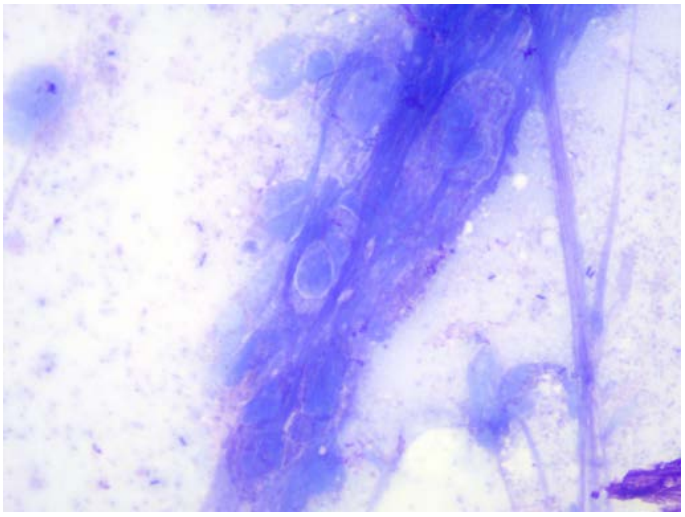

Figure 8. *Cytogram of smears from the wound surface on the 14th day after surgery using the device of high-frequency electrosurgery "KLS Martin" and suture material Caprosyn (3/0) - connective tissue fibers. Stained by Romanovsky. Magnification x1000.*

In addition, on the 14th day after surgery in groups of patients using suture material Caprosyn (3/0) there were phenomena of resorption of suture residues (Figure 12).

In groups of patients using suture material Polysorb (3/0), the pattern of resorption of suture material was observed on the 21st day after surgery (Figure 13).

On the 21st day after surgical interventions using radio-wave surgery device "Surgitron" and high-frequency electrosurgery device “KLS Martin” and the use of both sutures, cytograms of most patients revealed epithelial cells with small nuclei and a

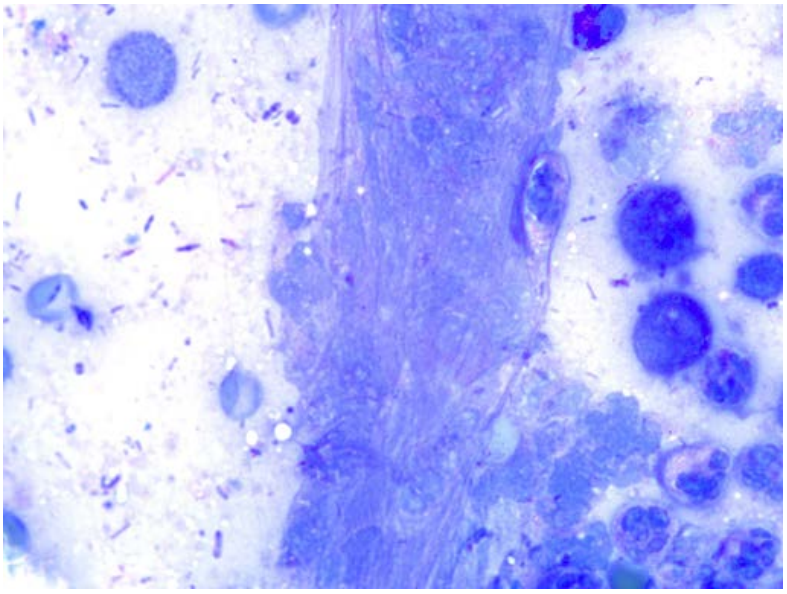

Figure 9. *Cytogram of smears from the wound surface on the 14th day after surgery using radio-wave surgery device "Surgitron" and suture material Polysorb (3/0) - connective tissue fibers with cellular elements between them, the presence of segmental neutrophils. Stained by Romanovsky. Magnification x1000.*

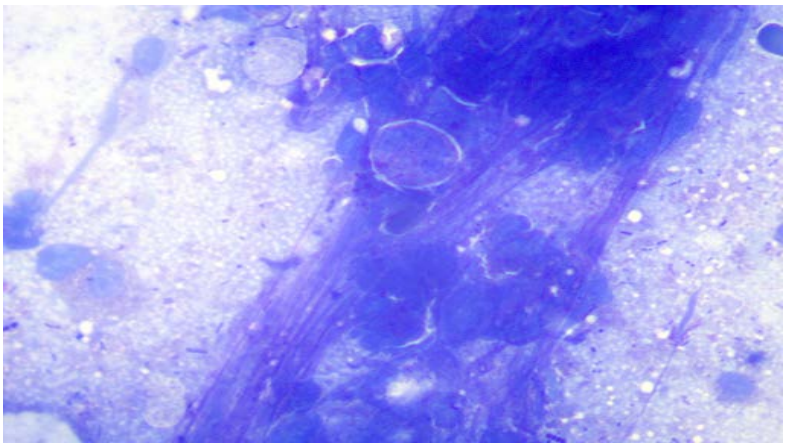

Figure 10. *Cytogram of smears from the wound surface on the 14th day after surgery using the device of high-frequency electrosurgery "KLS Martin" and suture material Polysorb (3/0) - connective tissue fibers with cellular elements between them. Stained by Romanovsky. Magnification x1000.*

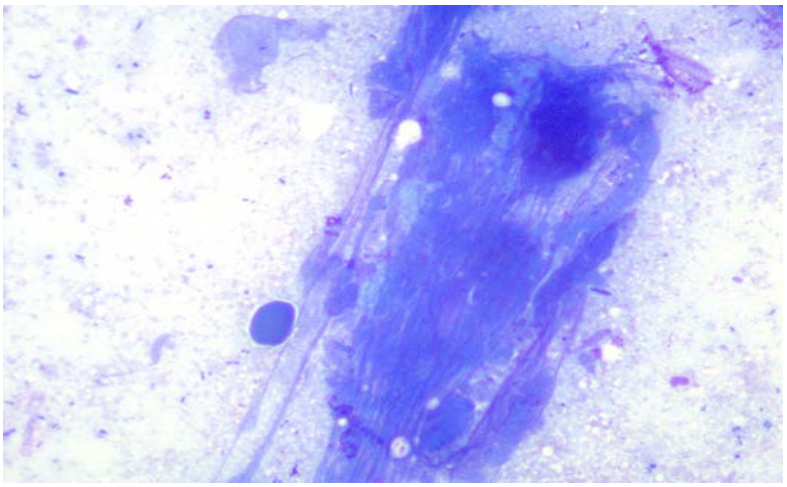

Figure 11. *Cytogram of smears from the wound surface on the 14th day after surgery using the device of high-frequency electrosurgery "KLS Martin" and suture material Caprosyn (3/0) - connective tissue fibers, the presence of process fibroblasts. Stained by Romanovsky. Magnification x1000.*

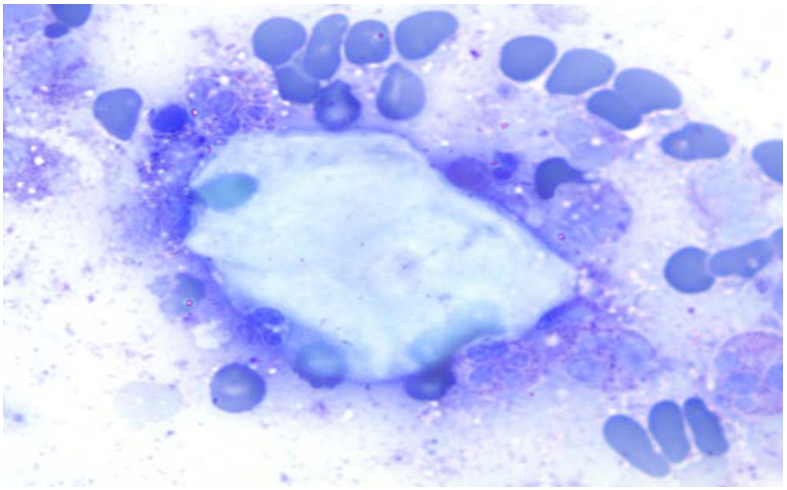

Figure 12. *Cytogram of a smear from the wound surface on the 14th day after surgery using of radio-wave surgery device "Surgitron" and suture material Caprosyn (3/0) - resorption of the remnants of suture material. Stained by Romanovsky. Magnification x1000.*

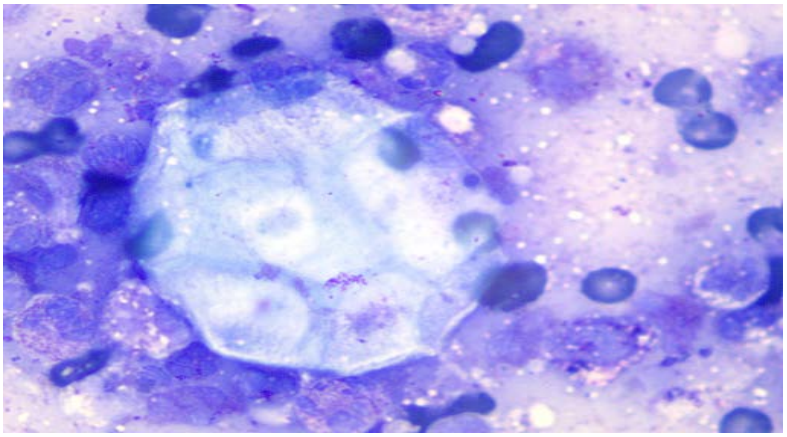

Figure 13. *Cytogram of the smear from the surface of the wound on the 21st day after surgery using of radio-wave surgery device "Surgitron" and suture material Polysorb (3/0) - resorption of suture residues. Stained by Romanovsky. Magnification x1000.*

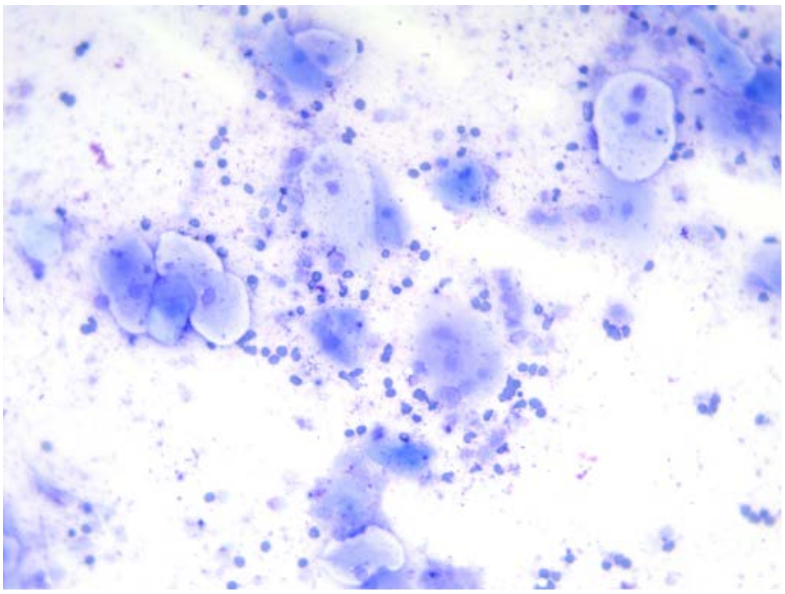

Figure 14. *Cytogram of smears from the wound surface on the 21st day after surgery using the device of high-frequency electrosurgery "KLS Martin" and suture material Caprosyn (3/0) - cells of mature multilayered squamous epithelium. Stained by Romanovsky. Magnification x400.*

significant amount of cytoplasm- cells of mature multilayered squamous epithelium, which was a sign of epithelialization processes (Figure 14).

Therefore, using of Caprosyn (3/0) suture material in patient groups was accompanied by a less pronounced neutrophilic tissue reaction lasting only 3-5 days comparing to the groups where Polysorb (3/0) was used as suture material, where the duration of neutrophilic reaction was slightly longer being 4-6 days. But application of radio-wave surgery device “Surgitron” and high-frequency electrosurgery device “KLS Martin” with using of suture material Caprosyn (3/0) and Polysorb (3/0) significantly reduces the neutrophilic tissue reaction in postoperative anal canal wounds, which lasted only 3-6 days, helping to reduce the time of their healing, while according to some authors, such inflammatory changes in the wounds of the anal canal can last up to 14-15 days [12].

The appearance of histiocytes in the groups of patients using suture material Caprosyn (3/0) occurred on 5-7 days, while in the groups using suture material Polysorb (3/0) histiocytes appeared on 6-8 days. Reparative changes characterized by the appearance of fibroblasts and loose connective tissue fibers in patients using suture material Caprosyn (3/0) were detected on 7-8 days and in patients using suture material Polysorb (3/0) - on 8-10 days.

Despite all the above differences between groups of patients using two different types of suture material in the early stages of wound healing, the formation of scar connective tissue occurred almost equally on 14-17 days with the formation of bundles of collagen fibers with cellular elements between them. Epithelialization processes, which were characterized by the appearance of cells of mature multilayered squamous epithelium, in two groups of patients using suture material Caprosyn (3/0) and Polysorb (3/0) also occurred simultaneously on 19-22 days.

Given the data obtained, we consider it appropriate to widely using of polyfilament suture material Polysorb (3/0) for surgical treatment of more difficult combined pathology of the anal canal and rectum, which may consist of a combination of 3-5 diseases (combined hemorrhoids, anal fistulas, anorectal abscesses, anal fissures) using modern radio surgical and high-frequency electrosurgical technologies to reduce purulent and inflammatory complications and occurrence of strictures of the anal canal in the postoperative period.

Using of radio-wave surgery device "Surgitron" and high-frequency electrosurgery device "KLS Martin" and suture material Caprosyn (3/0) and Polysorb (3/0) was not accompanied by complications such as bleeding, suppuration of postoperative wounds, anal strictures, and recurrence of diseases, which according to other authors occurred with a frequency of 2-15% [2,10,13,14].

Conclusion.

1. Application of radio-wave surgery device "Surgitron" and high-frequency electrosurgery device "KLS Martin" with using of suture material Caprosyn (3/0) and Polysorb (3/0) according to cytological examination of smears from wounds did not show significant differences in the timing of repair and epithelialization depending on the type of suture material.

2. Using of radio-wave surgery device "Surgitron" and high-frequency electrosurgery device "KLS Martin" and suture material Caprosyn (3/0) and Polysorb (3/0) was not accompanied by complications such as bleeding, suppuration of postoperative wounds, anal strictures, and recurrence of diseases.

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Conflict of Interest Information.

potential or apparent conflicts of interest related to this manuscript do not exist at the time of publication and are not anticipated.

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Резюме

Влияние разновидности шовного материала на заживление ран анального канала после комбинированных операций по поводу сочетанной аноректальной патологии с использованием современных технологий

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Актуальность проблемы сочетанной патологии анального канала и прямой кишки достаточно высока из-за отсутствия единого подхода к хирургическому лечению данной категории пациентов.

Целью исследования было провести сравнительную морфологическую оценку послеоперационного заживления ран у пациентов с сочетанной патологией аноректальной области после комбинированных операций с использованием различных видов шовного материала, а также современных аппаратов высокочастотной электрохирургии и радиоволновой хирургии.

Динамика раневого процесса под воздействием капросина (3/0) и полисорба (3/0) проведена у 60 пациентов первой и второй групп исследования, где использовались радиочастотный аппарат “Surgitron” и высокочастотный электрохирургический аппарат “KLS Martin”, так как они имели примерно одинаковую глубину коагуляционного некроза тканей, путем цитологического исследования мазков-отпечатков с поверхности послеоперационных ран на 3, 5, 7, 14 и 21 сутки.

Несмотря на все различия на ранних стадиях заживления ран между группами пациентов, использующих два разных типа шовного материала, формирование рубцовой соединительной ткани происходило почти одинаково на 14-17 сутки с образованием пучков коллагеновых волокон с клеточными элементами между ними. Процессы эпителизации, которые характеризовались появлением клеток зрелого многослойного плоского эпителия, у двух групп пациентов, использующих шовный материал Caprosyn (3/0) и Polysorb (3/0), также происходили одновременно на 19-22 дни.

Использование аппарата радиоволновой хирургии “Surgitron” и аппарата высокочастотной электрохирургии “KLS Martin” и шовного материала Капросин (3/0) и Полисорб (3/0) не сопровождалось такими осложнениями, как кровотечение, нагноение послеоперационных ран, анальные стриктуры и рецидивы заболеваний.

Ключевые слова: заживление ран, морфологическая оценка, шовный материал, комбинированная аноректальная патология, технологии радиоволновой хирургии и высокочастотной электрохирургии.