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EXPERIMENTAL RESEARCH OF THE POSSIBILITIES OF INFLUENCE ON HEALING SMALL INTESTINAL ANASTOMOSIS

Abstract. A promising area of further research is the use of a combination of components of tissue growth factors in combination with low-intensity electromagnetic effects of light radiation.

Objective. Investigation of various methods of influence on the healing of sutures of the small intestinal anastomosis in conditions of peritonitis.

Materials and methods. The experiment was conducted on 20 white Wistar male rats weighing 180-250 g, the content, care and methods of experimental work with which corresponded to the observance of the International Principles of the European Convention on the Protection of Vertebrate Animals (Strasbourg, 1985)

Results. The research work reflects the results of an experimental study, the purpose of which was to develop a method of sealing the small intestinal anastomosis under peritonitis. The experiment was performed on 20 white Wistar male rats weighing about 250 grams. The possibilities of using physical (light of a certain wavelength) and biological (tissue growth factors) methods in the prevention and treatment of acute inflammatory reactions and stimulation of reparative processes are shown. It is noted that a promising direction for further research on methods for the prevention of insolvency of small bowel anastomoses is the use of electromagnetic effects of low intensity of the light spectrum in combination with the application of tissue growth factors.

Conclusion. A promising direction for further research is the use of a combination of sealing lines with the application of components of tissue growth factors in combination with a low-intensity electromagnetic effect of light radiation.

Key words: *enteric anastomosis, anastomotic leakage, phototherapy, tissue growth factors, experiment.*

Introduction

It is known that the leading pathophysiological aspect in patients with failure of intestinal anastomoses (CA) are volemic and hemodynamic disorders, which are caused by reduced arterial inflow and impaired venous outflow due to compression of intramural vessels, sequestration of fluid into the lumen of the intestine and intestine [1, 2]. Endogenous intoxication and metabolic disorders in the inability of spacecraft are complex and multicomponent [3, 4]. The main source of endotoxemia in patients with insolvency is the intestine [5, 6]. Violation of the barrier function of the intestinal wall leads to endotoxemia, which in the absence of adequate treatment is progressive. The following factors are crucial in the further development of pathological changes: gradual depletion of the detoxification potential of the liver; translocation of intestinal microflora and its acquisition of pathogenic properties; growth of the total mass of toxic products in internal environments; development of systemic microcirculatory disorders in organs and tissues, disorders of cellular metabolism; develop-

ment and progression of peritonitis, the second source of intoxication [7, 8].

Experiment design. After laparotomy, the jejunum was crossed by s of the lumen, after which the abdominal cavity was sutured with occasional sutures. After 12 hours, relaparotomy, sanitation of the abdominal cavity and suturing of the small intestine were performed with a single prolene continuous suture. All experimental animals after relaparotomy were observed a large amount of intestinal discharge in all parts of the abdominal cavity, swelling of the parietal peritoneum with vascular injection. The effusion was evacuated and the abdominal cavity was sanitized with antiseptic solutions [9, 10].

All animals are divided into three groups. The *control group* included 5 rats, which performed a simulating operation (laparotomy / relaparotomy) and evaluated metabolic parameters. The *comparison group* consisted of 5 rats, who simulated EIA, studied the number of insolvency of jejunal sutures and mortality, as well as metabolic parameters. The *study group (SG)* consisted of 10 rats, which were modeled with AEP, 5 animals in two series.

SG A included animals that were sutured by the jejunum suture line after applying the components of tissue growth factors to the suture zone (0.5-1 ml) were covered with a synthetic wound coating PCL (polycaprolacton).

SG B included animals that, after applying the components of tissue growth factors (0.5-1 ml) to the zone of sutures and then covering the suture line with a synthetic coating, conducted electromagnetic irradiation of the zone of intestinal sutures with a wavelength of λ 660 nm (which corresponds to red light). The wavelength of the electromagnetic irradiation and the nature of the coating were chosen by us on the basis of literature data and the results of our own preliminary experimental studies [11, 12, 13, 14]. The surviving animals were removed from the experiment on the 5th day of the experiment by decapitation. As a source of electromagnetic irradiation, a quartz-polymer fiber with a diameter of 400 μ m was used, with a radiation wavelength of λ = 660 nm, and a radiation power of 50 mW.

The study used the methods of light microscopy, enzyme immunoassay, spectrophotometry. The parameters of the barrier function of oxygen-dependent and oxygen-dependent phagocytosis, the level of serum cytotoxicity, the concentration of circulating immune complexes and interleukins were studied.

The content, care and methods of experimental work with which corresponded to the observance of the International Principles of the European Convention on the Protection of Vertebrate Animals (Strasbourg, 1985) [15].

Statistical data processing was carried out on a MacBook Pro personal computer and a set of statistical programs from the MS Office package.

Results

In the course of experimental studies, it was found that in 100% of the rats of the comparative group, an insomnia of anastomotic sutures developed in the observation period of 4-7 days, which led to the death of animals within 6-15 days. (mortality in the group — 100%).

In SG A, there were no deaths in the early postoperative period. However, in 3 (60.0 %) Experimental animals, they refused to eat food and water for 4-5 days, were adynamic, and therefore were derived from the experiment. At the autopsy, there were signs of early adhesive intestinal obstruction (dilatation of the small intestine leading sections with the formation of loose conglomerate of intestinal loops in the intestinal sutures. No signs of intestinal sutures were found to be insignificant. One observation on the 8th day showed a clinical deterioration of the laboratory animal, it died on the 12th day of the experiment: At the opening, signs of partial insolvency of intestinal sutures with the development of diffuse peritonitis were noted.

In SG In the early postoperative period was favorable. In one observation (20.0 %) on the 10th day of the experiment, signs of intestinal obstruction were clinically detected, and therefore the animal was derived from the experiment. In the abdominal cavity in the region of the intestinal sutures, a single flat-sided fusion was determined, which was the cause of intestinal obstruction.

Phagocytic activity of granulocyte neutrophils and the metabolic potential in groups of experimental animals are: presented indicate a sharp inhibition of the metabolic potential of neutrophilic granulocytes and a tendency to stabilize against the background of combined physical and biological effects. Against the background of experimental peritonitis, a multiple increase in the level of CRP is observed, which after combined exposure decreased almost twofold.

In the course of the studies, it was found that against the background of peritonitis in animals, the cellular immunity is inhibited, and against the background of the combined physical and biological effects, their relative stabilization occurs (Table 1).

Table 1
Expression of T and B lymphocyte receptors in experimental animals

Subpopulation of lymphocytes	Control group (n=5)	Comparison group (n=5)	SG A (n=5)	SG B (n=5)
CD2+, %	NA	3,0 $\pm$ 1,1	5,0 $\pm$ 1,3	4,0 $\pm$ 1,6
CD3+, %	NA	7,0 $\pm$ 1,2	10,0 $\pm$ 1,3	8,0 $\pm$ 2,6
CD4+, %	NA	2,0 $\pm$ 1,8	6,0 $\pm$ 1,6	5,0 $\pm$ 3,0
CD8+, %	28,0 $\pm$ 2,6	5,0 $\pm$ 2,3	4,0 $\pm$ 2,4	3,0 $\pm$ 4,2
IRI,%	NA	1,5 $\pm$ 1,6	1,5 $\pm$ 0,9	1,7 $\pm$ 0,8

In the table 2 presents the results of determining proliferative activity in the reaction of blast transformation of lymphocytes.

Table 2
Proliferative activity in the reaction of blast transformation of lymphocytes

Experimental groups animals	Without mitogen stimulation (-ФГА),%	In the presence of mitogen (+ФГА), %	Stimulation index
Control group (n=5)	13,5 $\pm$ 2,5	23,5 $\pm$ 4,5	1,06 $\pm$ 1,3
Comparison group (n=5)	7,0 $\pm$ 0,9	18,0 $\pm$ 1,3	1,57 $\pm$ 0,5
SG A (n=5)	9,0 $\pm$ 1,2	17,0 $\pm$ 1,1	0,89 $\pm$ 0,3
SG B (n=5)	11,5 $\pm$ 2,5	21,5 $\pm$ 3,5	1,01 $\pm$ 1,3

As shown in the table 2 data, with experimental peritonitis there is a sharp inhibition of proliferative activity of lymphocytes with an increase in the RBTL stimulation index. In animals of subgroup 2A, an increase (- PHA), a decrease (+ PHA) and a stimulation index were noted. In animals of subgroup 2, the studied indices approached the control values.

A study of inflammatory mediators (IL-1, 6, and 10) in the blood serum of rats with EIAs of subgroups 2A and 2B showed an increase in the concentrations of IL-1 (by 20.1% and 18.5%, respectively) and IL-10 (by 17.7% and 14.3%, respectively), as well as a decrease in the level of IL-6 (by 14.8% and 19.7%, respectively) in blood serum compared with animals of the comparison group, which may indicate the start of anti-inflammatory immune reactions.

Discussion

In our opinion, the main mechanisms for implementing the effects of low-intensity electromagnetic radiation in the light range are associated with a modification of the immune status of the body in response to radiation, which is manifested in the mobilization of mature CD4 and CD8 T-lymphocytes, increasing IL-1 and IL-10 concentrations and reducing IL-6 levels and C-reactive protein in serum. Thus, through the inclusion of mediated signaling systems, a directed (anti-inflammatory) response of the organism to a combination of effective parameters of electromagnetic radiation can be carried out. The obtained results can serve as a basis for using low-intensity electromagnetic radiation of extremely high frequency in the complex for the prevention and treatment of various inflammatory diseases in order to increase the effectiveness of therapeutic measures.

A promising direction for further research is the use of a combination of sealing a suture line with the application of components of tissue growth factors (0.5-1 ml) in combination with a low-intensity electromagnetic effect of the light spectrum.

Conclusions

The use of physical and biological methods in the treatment of peritonitis caused by perforations of hollow organs, can more effectively maintain the stage of inflammation and stimulate repair processes, as they are a pronounced regulator of the stages of the inflammatory process and activate repair processes. The results obtained can serve as a basis for the use of low-intensity light exposure in the complex for the prevention and treatment of various inflammatory diseases in order to increase the effectiveness of therapeutic measures. The results of experimental studies may indicate that in conditions of a thin anastomosis, accompanied by a high level of development, and attempts to seal the anastomosis with different development options in the early and after the periodic period, the occurrence of adhesions cannot be caused by pathology. A promising direction for further research is the use of a combination of sealing lines with the application of components of tissue growth factors (0.5-1 ml) in combination with a low-intensity electromagnetic effect of light radiation.

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ВИВЧЕННЯ
В ЕКСПЕРИМЕНТІ
МОЖЛИВОСТЕЙ
ВПЛИВУ НА ЗАГОЄННЯ
ТОНКОКИШКОВИХ
АНАСТОМОЗІВ

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Реферат. Перспективним напрямком подальших досліджень є використання комбінації компонентів факторів росту тканин у поєднанні з низькоінтенсивним електромагнітним впливом світлового випромінювання.

Мета. Дослідження різних методів впливу на загоєння швів тонкокишкового анастомозу в умовах перитоніту.

Матеріали і методи. Експеримент виконано на 20 білих щурах-самцях лінії Вістар, вагою близько 250 грамів. Зміст, догляд та методи експериментальної роботи відповідають Міжнародним принципам Європейської конвенції про захист хребетних тварин (Страсбург, 1985 р.)

Результати. В роботі відображено результати експериментального дослідження, метою якого стала розробка методу герметизації швів тонкокишкового анастомозу в умовах перитоніту. Експеримент виконано на 20 білих щурах-самцях лінії Вістар, вагою близько 250 грамів. Показано можливості застосування фізичних (світло певної довжини хвилі) та біологічних (тканинні фактори росту) методів в профілактиці і лікуванні гострих запальних реакцій та стимуляції репаративних процесів. Відмічено, що перспективним напрямом подальшого дослідження методів профілактики неспроможності тонкокишкових анастомозів є застосування електромагнітного впливу низької інтенсивності світлового спектру в комбінації з аплікацією тканинних факторів росту.

Висновки. Перспективним напрямком подальших досліджень є використання комбінації ущільнювальних ліній із застосуванням компонентів факторів росту тканин у поєднанні з низькоінтенсивним електромагнітним впливом світлового випромінювання.

Ключові слова: тонкокишковий анастомоз, неспроможність анастомозу, фототерапія, тканинні фактори росту, експеримент.

ИССЛЕДОВАНИЕ ВЛИЯНИЯ ТКАНЕВЫХ ФАКТОРОВ РОСТА И ЭЛЕКТРОМАГНИТ- НОГО ИЗЛУЧЕНИЯ СВЕТОВОГО ДИАПАЗОНА НА ТОНКОКИШЕЧНЫЕ АНАСТОМОЗЫ В УСЛОВИЯХ ЭКСПЕРИМЕНТА

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Реферат. Перспективным направлением дальнейших исследований является использование комбинации компонентов факторов роста тканей в сочетании с низкоинтенсивным электромагнитным воздействием светового излучения.

Цель. Исследование различных методов влияния на заживление швов тонкокишечного анастомоза в условиях перитонита.

Материалы и методы. Эксперимент выполнен на 20 белых крысах-самцах линии Вистар, весом около 250 граммов. Содержание, уход и методы экспериментальной работы соответствуют Международным принципам Европейской конвенции о защите позвоночных животных (Страсбург, 1985 г.).

Результаты. В работе отражены результаты экспериментального исследования, целью которого стала разработка метода герметизации швов тонкокишечного анастомоза в условиях перитонита. Эксперимент выполнен на 20 белых крысах-самцах линии Вистар, весом около 250 граммов. Показаны возможности применения физических (свет определенной длины волны) и биологических (тканевые факторы роста) методов в профилактике и лечении острых воспалительных реакций и стимуляции репаративных процессов. Отмечено, что перспективным направлением дальнейшего исследования методов профилактики несостоятельности тонкокишечных анастомозов является применение электромагнитного воздействия низкой интенсивности светового спектра в сочетании с аппликацией тканевых факторов роста.

Выводы. Перспективным направлением дальнейших исследований является использование комбинации уплотнительных линий с применением компонентов факторов роста тканей в сочетании с низкоинтенсивным электромагнитным воздействием светового излучения.

Ключевые слова: тонкокишечный анастомоз, несостоятельность анастомоза, фототерапия, тканевые факторы роста, эксперимент.