ANNOTATION

of PhD thesis by Fakhradiyev Ildar Rafisovich on the topic «**Transdermal electrical myostimulation of the muscles of the anterior abdominal wall for the prevention of postoperative adhesions of the peritoneum (experimental study)»**, submitted for the degree of Doctor of Philosophy (PhD) in the specialty 6D110100 – «Medicine»

Relevance of the research topic.

Surgical procedures are the main cause of the development of the adhesive process *[Boland GM, Weigel RJ. Formation and prevention of postoperative abdominal adhesions. J Surg Res 2006; 132:3]*. Despite the difference in etiology, often only surgical intervention in the abdominal cavity can cause the formation of an adhesive process *[Ayushinova N.I., Grigoriev E.G., Chepurnykh E.E., Shurygina I.A. Adhesive disease - an unsolved problem of abdominal surgery // Sib. med. zhurn. (Irkutsk). 2018. №2.]*.

Postoperative adhesions remain one of the most difficult and unresolved problems in surgical practice. And although peritoneal adhesions may occur after each abdominal operation, the density, the time interval for the development of symptoms, as well as the clinical picture itself vary greatly and has no predictable patterns *[Moris D, Chakedis J, Rahnemai-Azar AA, Wilson A, Hennessy MM, Athanasiou A, Beal EW, Argyrou C, Felekouras E, Pawlik TM. Postoperative Abdominal Adhesions: Clinical Significance and Advances in Prevention and Management. J Gastrointest Surg. 2017 Oct;21(10):1713-1722. doi: 10.1007/s11605-017-3488-9]*.

The formation of adhesions after invasive intervention was first discovered more than 1,500 years ago, when pulmonary adhesions were described as a traumatic reaction to a lung puncture [*Wiseman DM. Disorders of adhesions or adhesion-related disorder: monolithic entities or part of something bigger–CAPPS? Seminars in reproductive medicine. 2008;26(4):356–68. doi:10.1055/s-0028-1082394]*. With the development of abdominal surgery since the end of the nineteenth century, information about clinically significant abdominal adhesions has increasingly appeared in the literature *[Kostyrnoy A.V., Groyzik K.L., Mustafaeva S.R. Adhesive peritoneal disease: present and future problems. Tauride medico-biological Bulletin. 2013; 16: 1-3 (61): 262-267]*. Thus, due to the rapid growth of various types of surgical interventions on the abdominal organs, there was an increasing need for the prevention of peritoneal adhesions.

Strategies for preventing the development of the adhesive process can be divided into four categories: general principles, surgical methods, mechanical barriers and chemical agents *[Schnüriger B, Barmparas G, Branco BC, Lustenberger T, Inaba K, Demetriades D. Prevention of postoperative peritoneal adhesions: a review of the literature. Am J Surg 2011;201: 111-121]*.

However, many authors suggest that only a combination of these methods can contribute to effective anti-adhesive activity. For example, in order to increase the

chances of preventing the development of the adhesive process, the use of specialized anti-adhesion adjuvants should undoubtedly be supplemented to the effectiveness of a good surgical technique *[Imudia AN, Kumar S, Saed GM, Diamond MP. Pathogenesis of Intra-abdominal and pelvic adhesion development. Semin Reprod Med. 2008 Jul;26(4):289-97. doi: 10.1055/s-0028-1082387]*.

Also, today there are several groups of drugs against the development of postoperative peritoneal adhesions *[Tang J, Xiang Z, Bernards MT, Chen S. Peritoneal adhesions: Occurrence, prevention and experimental models. Acta Biomater. 2020 Oct 15;116:84-104. doi: 10.1016/j.actbio.2020.08.036]*.

The role of one of the groups of drugs may vary in the activation of fibrinolysis *[Tang J, Xiang Z, Bernards MT, Chen S. Peritoneal adhesions: Occurrence, prevention and experimental models. Acta Biomater. 2020 Oct 15;116:84-104. doi: 10.1016/j.actbio.2020.08.036]*, preventing blood clotting and reducing the inflammatory response *[regulates key signaling molecules in the pathogenesis of postoperative tissue fibrosis, Reprod. Sci. 26 (6) (2019) 724–733]*.

Another group of drugs are anti-adhesive barriers, which in turn are divided into solid, liquid or hydrogels by structure *[Park JS, Lee JH, Han CS, Chung DW, Kim GY. Effect of hyaluronic acid-carboxymethylcellulose solution on perineural scar formation after sciatic nerve repair in rats. Clin Orthop Surg. 2011 Dec;3(4):315-24. doi: 10.4055/cios.2011.3.4.315]*, жидкие *[Chen WH, Lin H, Fu HC, Wu CH, Tsai CC, Ou YC. Effects of Icodextrin Solution (Adept®) on Ovarian Cancer Cell Proliferation in an In Vitro Model. Medicina (Kaunas). 2022 Mar 4;58(3):386. doi: 10.3390/medicina58030386]* или гидрогели по структуре *[Pepe A, Maio L, Bracalello A, Quintanilla-Sierra L, Arias FJ, Girotti A, Bochicchio B. Soft Hydrogel Inspired by Elastomeric Proteins. ACS Biomater Sci Eng. 2021 Nov 8;7(11):5028-5038. doi: 10.1021/acsbiomaterials.1c00817]*. The role of anti-adhesive barriers is to create a barrier between adjacent wound surfaces.

However, numerous studies on the effectiveness of these anti-adhesive barriers have shown that none of them, as it was found, not only completely prevent the development of adhesions *[Alpay Z, Saed GM, Diamond MP. Postoperative adhesions: from formation to prevention. Semin Reprod Med. 2008 Jul;26(4):313-21. doi: 10.1055/s-0028-1082389]*, but also can cause serious side effects *[David M, Sarani B, Moid F, Tabbara S, Orkin BA. Paradoxical inflammatory reaction to Seprafilm: case report and review of the literature. South Med J. 2005 Oct;98(10):1039-41. doi: 10.1097/01.smj.0000182133.98781.19]*. For example, anti-inflammatory drugs, in addition to reducing inflammation, can also contribute to the occurrence of infection, slowing down the overall healing of wounds *[C.D. Mills, M1 and M2 macrophages: oracles of health and disease, Crit. Rev.Immunol. 32 (2012) 463–488]*, and drugs that activate fibrinolysis and anticoagulants *[G. Acun, H. Ozdemir, O. Sunamak, Z.U. Ozdemir, E. Baskan, M. Yazi, B. Savas,U. Berberoglu, The effect of single-dose intraperitoneal bevacizumab on peritoneal adhesion formation, Revista De Investigacion Clinica-Clin. Transl. Investig. 70 (6) (2018) 279–284]* can cause the risk of bleeding *[E.J. Macarak, C.E. Lotto, D. Koganti, X. Jin, P.J. Wermuth, A.-K. Olsson, M. Montgomery, J. Rosenbloom,*

Trametinib prevents mesothelial-mesenchymal transition and ameliorates abdominal adhesion formation, J. Surg. Res.227 (2018) 198–210].

Special attention is paid to the issue of early activation of patients from the point of view of rehabilitation in the postoperative period, also due to the reduction of hospital stay time*[Browning L, Denehy L, Scholes RL. The quantity of early upright mobilisation performed following upper abdominal surgery is low: an observational study. Aust J Physiother. 2007;53(1):47-52. doi: 10.1016/s0004-9514(07)70061-2]*.

In patients, impaired postoperative motility is considered normal, lasting on average 1-2 days for the small intestine and 2-3 days for the colon *[Livingston EH, Passaro EP Jr. Postoperative ileus. Dig Dis Sci. 1990; 35(1):121–32]*. It is possible that this stagnation contributes to the development of adhesions, since the key period for the formation of adhesions falls on the first day after the operation, and the absence of perestaltic movements, in turn, increase the area of intestinal adhesion.

And in this regard, the mechanical separation of the peritoneal surfaces for a period sufficient for peritoneal healing is especially important, since it allows localizing the prevention of adhesions *[Thompson J. Pathogenesis and prevention of adhesion formation. Dig Surg. 1998;15(2):153-7. doi: 10.1159/000018610]*.

Attempts to stimulate peristalsis and thus prevent the formation of adhesions have been made using drugs such as cisapride *[Springall RG, Spitz L. The prevention of post-operative adhesions using a gastrointestinal prokinetic agent. J Pediatr Surg. 1989 Jun;24(6):530-3. doi: 10.1016/s0022-3468(89)80499-3]*, and although it is difficult to find convincing evidence of the benefits of these methods, some experimental studies in the field of abdominal surgery show that manual therapy, namely, postoperative massage of the anterior abdominal wall in the early postoperative period, can be it is useful for preventing adhesions after surgery *[Bove GM, Chapelle SL, Hanlon KE, Diamond MP, Mokler DJ. Attenuation of postoperative adhesions using a modeled manual therapy. PLoS One. 2017; 12(6):e0178407]*.

However, this technique has not yet been used in clinical practice, and its application has remained at the level of experimental research, although it has shown quite positive results.

According to the authors, such prevention did not interfere with healing and did not cause undesirable complications, and this was due to the fact that the preserved movements of damaged structures in the immediate postoperative period can potentially serve as an effective prevention of weakening the development of cohesive postoperative adhesion, since the movement of organs destroys the initially formed adhesions of deposited fibrin, preventing their settlement *[Bove GM, Chapelle SL, Hanlon KE, Diamond MP, Mokler DJ. Attenuation of postoperative adhesions using a modeled manual therapy. PLoS One. 2017; 12(6):e0178407]*.

It was previously published that mechanical massage performed on the muscles of the anterior abdominal wall using a manual device immediately after abdominal surgery was recognized as safe to use and effective in reducing postoperative intestinal obstruction *[Le Blanc-Louvry I, Costaglioli B, Boulon C, Leroi AM, Ducrotte P. Does mechanical massage of the abdominal wall after*

colectomy reduce postoperative pain and shorten the duration of ileus? Results of a randomized study. J Gastroint Surg. 2002;6(1):43–9].

Movements between organs and the abdominal wall are necessary for adaptation to peristalsis and a highly variable intestinal volume, and in experiments, visceral mobilization aimed at increasing mobility between organs reduced the formation of adhesions *[Bove GM, Chapelle SL. Visceral mobilization can lyse and prevent peritoneal adhesions in a rat model. J Bodyw Mov Ther. 2012 Jan;16(1):76-82. doi: 10.1016/j.jbmt.2011.02.004]*.

However, given that in the early postoperative period, strengthening motor activity in a natural way is difficult, and the use of massage techniques does not have standard procedures, there is a need for artificial local stimulation of the muscles of the anterior abdominal wall.

Thus, this study was aimed at evaluating the effectiveness of transdermal electrical myostimulation of abdominal wall muscles in the prevention of postoperative adhesions (in an experiment).

The aim of the dissertation research is to study the effectiveness of transdermal electrical myostimulation of abdominal wall muscles in the prevention of postoperative adhesions (in an experiment).

Research objectives.

1. To substantiate the expediency of using transdermal electrical myostimulation of abdominal wall muscles in the prevention of postoperative abdominal adhesions.
2. To study the effect of various parameters of the electric current of transdermal myostimulation of abdominal wall muscles on the motility of the gastrointestinal tract in an experiment.
3. To develop and evaluate the safety of using the method of transdermal electrical myostimulation of the muscles of the anterior abdominal wall in the conditions of modeling intestinal anastomosis during intestinal resection in an experiment.
4. To give a comparative characteristic of the effectiveness of the use of transdermal myostimulation of the muscles of the anterior abdominal wall and the anti-adhesive barrier in the prevention of postoperative adhesions in experimental conditions.
5. To evaluate the anti-adhesive effect of the use of transdermal electrical myostimulation of the muscles of the anterior abdominal wall in an experiment.

Object and subject of research.

The study was conducted in the Laboratory of Experimental Medicine of the B. Atchabarov Research Institute of Fundamental and Applied Medicine, S.D. Asfendiyarov Kazakh National Medical University, Almaty, Kazakhstan.

The animals were kept and the experiment was carried out in accordance with the international rules "Guide for the Care and Use of Laboratory Animals" (National Research Council, 2011), as well as with the ethical principles of the European Convention for the Protection of Vertebrates, for experimental and other scientific purposes (Strasbourg, 2006).

The study used 392 rabbits, chinchilla breeds, weighing from 3500 to 4500 g, obtained from the vivarium of the B. Atchabarov Research Institute of Fundamental and Applied Medicine (Almaty, Kazakhstan) with a standard diet and care.

The study consisted of two blocks:

Block I - safety assessment of transdermal electrical myostimulation of the anterior abdominal wall, (n -264);

Block II - evaluation of the effectiveness of transdermal electrical myostimulation of the anterior abdominal wall, (n- 128);

I block. Safety assessment of transdermal electrical myostimulation of the anterior abdominal wall

The safety assessment of transdermal myostimulation of the anterior abdominal wall was carried out on 264 laboratory animals (rabbits).

Animals were randomly assigned to 4 groups. Animals of groups 2 and 4 are divided into 3 series.

Group I: Control Group (CG_S): without any intervention (n=18).

Group II: Comparison group (TG_S): Application of transdermal electrical myostimulation of the anterior abdominal wall (n=54).

- Series 1 – Parameters of electric current (frequency – 0.1-0.5 kHz, current 5-10 mA) (n=18).
- Series 2 - Parameters of electric current (frequency – 1-2 kHz, current 10-15 mA) (n=18).
- Series 3 - Parameters of electric current (frequency - 2-3 kHz, current 15-20 mA) (n=18).

Group III: comparison group (AG_S): Resection of the intestine, formation of intestinal anastomosis (n=48).

Group IV: Experienced group (TAG_S): Resection of the intestine, formation of intestinal anastomosis + application of transdermal electrical myostimulation of the anterior abdominal wall (n=144).

- Series 1 – Parameters of electric current (frequency – 0.1-0.5 kHz, current 5-10 mA) (n=48).
- Series 2 - Parameters of electric current (frequency - 1-2 kHz, current 10-15 mA) (n=48).
- Series 3 - Parameters of electric current (frequency – 2-3 kHz, current 15-20 mA) (n=48).

Transdermal electrical myostimulation of the anterior abdominal wall

To perform this manipulation, laboratory animals were placed in a PLAS-LABS (USA) retainer for 24 hours. Transdermal electrical myostimulation of the anterior abdominal wall was performed according to the method developed by us *[Fakhradiev I.R., Almabaev Y.A., Ahmad N.S., Salimgereeva B., Ermentaeva Zh.M., Almabaev G.Y., Atnabaev B.D., Kaketaeva I.Z. Method of prevention of postoperative adhesive process of the abdominal cavity . No. 34805, 2019/0665.1]*.

Transdermal electrical myostimulation of abdominal muscles was performed for 24 hours. As part of the study, the duration of the stimulation period was 15 minutes with a relaxation period of 45 minutes for 24 hours. This duty cycle was chosen in order to reduce the process of anaerobic glycolysis and ATP resynthesis

in muscles *[Filipovic, Andre; Kleinöder, Heinz; Dörmann, Ulrike; Mester, Joachim Electromyostimulation—A Systematic Review of the Effects of Different Electromyostimulation Methods on Selected Strength Parameters in Trained and Elite Athletes, Journal of Strength and Conditioning Research: September 2012 - Volume 26 - Issue 9 - p 2600-2614 doi: 10.1519/JSC.0b013e31823f2cd1]*.

Intestinal resection, formation of intestinal anastomosis

To perform this manipulation, animals with a pre—carefully shaved surgical field under general anesthesia (Calypsol — 10 mg / kg; Listenone — 1.0 mg / kg; Propofol – 1% 1.5-2.5 mg / kg; the dose and time of administration of substances were noted in the journal of the experiment) were fixed on the machine in the supine position. A peripheral catheter was inserted into the marginal vein of the ear, sensors for electrocardiography were attached to the chest, a pulse oximeter sensor for monitoring peripheral blood oxygen saturation was fixed on the tongue.

At the next stage, the animals were intravenously injected with a muscle relaxant (Arduan — 0.05 mg/kg) and tracheal intubation was performed according to the method of D.I. Vachnadze *[Vachnadze D.I., Breshenkov D.G., Dydykin S.S. Anesthesiological manual in pigs as a model object in biomedical and biotechnological research. Questions of reconstructive and plastic surgery 2016; 4(59): 37-56]*, for which a curved Macintosh-type blade and an endotracheal tube with a diameter of 2 mm were used. Before placing the tube during direct laryngoscopy, irrigation of the glottis with lidocaine was performed, the tubes were lubricated with lubricant.

After tracheal intubation, the adequacy of the tube position was checked by auscultation method. Potentiation of the action of propofol and analgesics was carried out using the drug Droperidol at a dose of 0.3 mg/ kg of body weight every 45 minutes using an automatic Perfusor Compact syringe pump (B. Braun, Germany). The animal was connected to a ventilator Ventilator No. 128 (Russia).

The skin of the abdominal wall was treated with a solution of chlorhexidine and 70% alcohol. The abdominal cavity was opened with upper-median access. After revision of the abdominal organs, 80 mg of gentamicin (2 ml of 4% solution) was intraperitoneally administered to all laboratory animals in order to prevent purulent complications.

A loop of the small intestine was removed into the wound, retreating 5 cm from the ileocecal angle, and isolated with gauze napkins. In the middle of the removed loop, resection was performed proximally for 4 centimeters.

The anastomosis was performed according to the "end-to-end" type with a continuous oblique extramucose suture developed by us *[Patent for invention No. 33460 dated 10.11.2017. The method of applying intestinal anastomosis // Kuandykov E.K., Li S.V., Almabaev Y. A., Almabaeva A.Y., Almabaev G.Y., Fakhradiev I.R.]*. At the final stage of surgical intervention, the abdominal cavity was sanitized with an aqueous solution of chlorhexidine, drained with gauze balls and sutured tightly in layers.

Laboratory animals were removed from anesthesia by stopping the administration of anesthetic drugs. After the appearance of stable spontaneous

respiration, extubation was performed, then the animal was transferred to the Vivarium of the B. Atchabarov Institute of Biological Sciences.

The method of anesthesia in the postoperative period is Ketonal – 20 mg / kg, during the first day. An experimental group of laboratory animals (TAGS), after performing a surgical procedure, was placed in a PLAS-LABS (USA) retainer for 24 hours to perform transdermal electrical myostimulation of the anterior abdominal wall described earlier.

II block. Evaluation of the effectiveness of transdermal electrical myostimulation of the anterior abdominal wall

The effectiveness of transdermal electrical myostimulation of the anterior abdominal wall was evaluated on 128 laboratory animals (rabbits).

The animals were randomly distributed into 4 groups, in each group the number of animals was 32 heads:

Group I: control group (CG_E): modeling of the adhesive process of the abdominal cavity (n=32).

Group II: comparison group (SF_E): Modeling of the adhesive process of the abdominal cavity with the subsequent use of the anti-adhesive barrier Seprafilm® (n=32).

Group III: comparison group (TES_E): Modeling of the adhesive process of the abdominal cavity with the subsequent application of transdermal electrical myostimulation of the anterior abdominal wall (n=32).

Group IV: Comparison group (TES_E): Modeling of the adhesive process of the abdominal cavity with the subsequent use of transdermal electrical myostimulation of the anterior abdominal wall in combination with the anti-adhesive barrier Seprafilm® (n=32).

Modeling of the adhesive process of the abdominal cavity

In order to simulate the adhesive process of the abdominal cavity, the method developed and patented by us *[Utility model patent No. 4280 dated 26.03.2019. Method of modeling the adhesive process of the abdominal cavity // Fakhradiev I.R., Almabaev Y.A., Fazylov T.R.]* on laboratory animals, the latter were subjected to the use of an anesthetic manual according to the method described above.

Further, under aseptic conditions, a 5 cm long incision was made along the midline of the abdomen to expose the small intestine. After performing the access, the small intestine was carefully removed from the cavity and covered with wet wipes. To form the adhesive process, scarification of the anterior surface of the small intestine was used at moderate pressure using a toothbrush with nylon bristles, forming a subserous ecchymotic zone measuring 3 by 2 cm. Then the small intestine was placed back into the abdominal cavity in its original position. The parietal peritoneum and the musculofacial layer were sutured in layers using a 3/0 absorbable suture material (Vicryl, Johnson & Johnson).

In group II (SF_E), after modeling the adhesive process of the abdominal cavity according to the above technique, the anti-adhesive drug Seprafilm® was applied to the small intestine as a prevention of the development of adhesions according to the standard procedure before closing the surgical wound. Restoration of the integrity of the skin was performed with an intermittent silk suture 3/0.

In group III (TES_E), laboratory animals, after modeling the adhesive process of the abdominal cavity, restored the integrity of the skin with an intermittent 3/0 silk suture using the above technique. Subsequently, transdermal electrical myostimulation of the anterior abdominal wall was applied according to the previously described technique.

Laboratory animals were removed from anesthesia by stopping the administration of anesthetics. In the postoperative period, antibiotics and antimicrobial agents were not used.

Visual, instrumental and morphological research methods

To assess the safety and effectiveness of transdermal electrical myostimulation of the anterior abdominal wall, visual, instrumental and morphological research methods were also used (thermometry of the anterior abdominal wall area, assessment of pain response on the Grimace scale, monitoring of motor activity, assessment of intestinal peristalsis, measurement of deformation and strength indicators of anastomosis, assessment of postoperative wound healing, histological examination of small intestine samples).

Assessment of the adhesive process of the abdominal cavity

The assessment of the adhesive process of the abdominal cavity was performed in animals of all groups I and II of the study blocks, and was carried out on the 1st, 3rd, 7th and 14th days from the beginning of the experiment. According to these terms, laboratory animals in all groups were removed from the experiment. Lethal doses of sodium thiopental administered intravenously and a saturated solution of potassium chloride were used to withdraw from the experiment. During autopsy, exsanguination was performed, which was performed by opening the chest and then piercing the heart to prevent blood from entering during the assessment of the adhesive process.

The autopsy procedure of each animal was recorded using a digital video camera (Canon PowerShot G1 X Mark III, Japan). The abdominal cavity was opened, starting with the xiphoid process with a wide oval cutout along the edge of the abdominal wall, exposing the area of modeling the adhesive process.

Then a systematic examination of the abdominal cavity was performed, detection and destruction of the formed adhesions. The interval of each video varied from 2.5 to 4 minutes.

A total of 128 were filmed in the II block of the study to assess the prevalence and characteristics of the adhesive process. The captured video files were shown to 25 research surgeons who did not participate in the study and who were not informed about the design of the study, but were trained in the correct assessment of the adhesive process. Intraperitoneal adhesions were evaluated from 0 (absence) to 4 (severe process) in accordance with the Canbaz scale of assessment of the severity of the adhesive process (CSS) *[Yilmaz Y, Celik IH, Pampal A, Demirel G, Topal F, Oguz SS, Kilicoglu SS, Ozen IO, Dilmen U. Effects of different pulmonary surfactants in the prevention of postoperative intraabdominal adhesion formation. J Pediatr Surg. 2012 Aug;47(8):1560-5]*.

Scientific novelty.

1. A method has been developed for modeling the adhesive process of the abdominal cavity under experimental conditions (Utility model Patent No. 4280 dated 26.03.2019. Method of modeling the adhesive process of the abdominal cavity// Fakhradiev I.R., Almabaev Y.A., Fazylov T.R.).
2. A method of transdermal electrical myostimulation of the muscles of the anterior abdominal wall has been developed under experimental conditions (Patent for invention No. 34805 of 11.09.2019. Method of prevention of postoperative adhesive process of the abdominal cavity // Fakhradiev I.R., Almabaev Y.A., Ahmad N.S., Salimgereeva B., Ermentaeva Zh.M., Almabaev G.Y., Tanabaev B.D., Kaketaeva I.Z.).
3. The safety of transdermal electrical myostimulation of the muscles of the anterior abdominal wall in experimental conditions was investigated.
4. The peculiarity of the course of the postoperative period with the use of transdermal electrical myostimulation of the muscles of the anterior abdominal wall was determined, and its effectiveness was also evaluated.
5. It has been shown that transdermal electrical myostimulation of the muscles of the anterior abdominal wall has an anti-adhesive effect.
6. The features of the course of the postoperative period when using the anti-adhesive barrier agent Seprafilm® in the experiment were determined.

Provisions to be defended.

1. The morphological characteristics of adhesions, the healing process of defects of the peritoneum and abdominal organs were evaluated when using methods of prevention of postoperative adhesions with the adhesive barrier Seprafilm®.
2. A method of transdermal electrical myostimulation of the muscles of the anterior abdominal wall has been developed in an experiment.
3. It is proved that the developed method of modeling the adhesive process enhances the adhesion of the inner surfaces of the abdominal wall in experimental animals.
4. Using an experimental model of adhesion formation, the method of objective assessment of the adhesive process is determined, which determines its clinical and morphological parallels.
5. The method of complex morphological diagnosis of postoperative adhesions by comparing video documentation allows us to reliably assess and compare the impact of various methods of prevention of adhesions at the macro- and microscopic level.
6. The method of transdermal electrical myostimulation of the muscles of the anterior abdominal wall is superior to the anti-adhesive barrier drug Seprafilm® in terms of prevention of postoperative adhesions in qualitative and quantitative ratio.

Practical significance of the obtained results.

Qualitatively new data on the course of the adhesive process in the abdominal cavity at various times have been obtained.

In the experiment, a model of the adhesive process of the abdominal cavity was created.

The results of comparative safety and effectiveness of transdermal electrical myostimulation of the muscles of the anterior abdominal wall with individual use,

as well as in combination with the anti-adhesive barrier Seprafilm® for use in order to prevent the formation of abdominal adhesions in the experiment.

It is proved that transdermal electrical myostimulation of the muscles of the anterior abdominal wall in experimental animals significantly reduces the formation of adhesions compared with the control.

The method of transdermal electrical myostimulation of the muscles of the anterior abdominal wall can be used in clinical practice for the prevention of abdominal adhesions.

Conclusions.

1. Weakening of the development of cohesive postoperative adhesion in the early postoperative period (the first day) is possible due to the destruction of deposited fibrin, preventing its settlement by increasing mobility between the parietal and visceral peritoneum through the use of transdermal myostimulation.
2. The use of optimal parameters of electric current (frequency – 1-2 kHz, current strength - 10-15 mA) of transdermal myostimulation of the muscles of the anterior abdominal wall allows to strengthen the motility of the gastrointestinal tract in comparison with the control group ($p < 0.05$).
3. The developed method of transdermal electrical myostimulation of the muscles of the anterior abdominal wall is safe and painless, and also does not interfere with the regenerative process of the surgical wound and the formed intestinal anastomosis in comparison with the control group in experimental animals
4. Transdermal electrical myostimulation of the muscles of the anterior abdominal wall reduces the development of the postoperative adhesive process in comparison with the anti-adhesive barrier Seprafilm® ($p = 0.03$) and the control group ($p = 0.02$).
5. The proposed method of using transdermal electrical myostimulation of the muscles of the anterior abdominal wall has an anti-adhesive effect that can prevent the development of the adhesive process of the abdominal cavity in the experiment.

Approbation of the results of the dissertation.

The main provisions of the dissertation were reported and discussed at the international scientific and practical conference of the Abuali Ibni Sino TSMU "Achievements and problems of fundamental science and clinical medicine", Dushanbe, 2020; XIV International Scientific and

Practical conference in memory of Academician Yu.I. Borodin "Lymphology: from basic research to medical technologies", Novosibirsk, 2021;

The approbation of the dissertation work took place at an expanded meeting of the Department of Anatomy of KazNMU named after S.D. Asfendiyarov (2022).

Personal contribution of a doctoral candidate.

Personally, the dissertator, under the guidance of scientific consultants, conducted the experimental part of the study, carried out a thorough analysis, statistical processing of data and interpretation of the results obtained during the study, reasonable conclusions and practical recommendations were made.

Implementation of research results into practice.

3 security documents were obtained from them:

1 patent for the invention of the Republic of Kazakhstan No. 34805 dated 11.09.2019. Method of prevention of postoperative adhesive process of the abdominal cavity

1 – patent for utility model No. 4280 dated 26.03.2019. A method for modeling the adhesive process of the abdominal cavity.

1 Eurasian patent for invention No. 2019/0665.1. Method of prevention of postoperative adhesive process of the abdominal cavity.

Publications.

According to the results of the study, 9 scientific papers were published: 6 of them – in journals, according to the recommendation of the Committee for Quality Assurance in the Sphere of Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan; 1 – in the journal included in the international database Web of Science Core Collection (Clarivate Analytics) Q1, (WJOS); 2 – in the materials of international conferences; 3 security documents were obtained: 1 of them- patent for the invention of the Republic of Kazakhstan, 1 of them – utility model of the Republic of Kazakhstan, and 1 of them – Eurasian patent for the invention.

The scope and structure of the thesis.

The dissertation is presented on 136 pages of typewritten text and consists of a list of abbreviations and designations, an introduction, a literature review, a description of materials and methods, the results of their own research, a conclusion including conclusions, practical recommendations and a list of references. The work is illustrated with drawings, diagrams, tables. The bibliographic index includes 266 sources.