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PATHOGENETIC RATIONALE FOR PHYSIOTHERAPEUTIC METHODS FOR PAIN RELIEF AFTER BREAST ENDOPROSTHETICS

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Abstract. ***Introduction.*** Breast augmentation is the most common aesthetic surgical intervention. However, endoprosthetics using silicone implants is often accompanied by a number of negative consequences in the postoperative period, including severe pain. One of the possible ways to solve this problem is the intramuscular injection of botulinum toxin followed by the use of electromagnetic influence in the field of endoprosthetics. ***Purpose of the study:*** to evaluate the effectiveness of the combined use of intramuscular injection of butolotoxin followed by the use of electromagnetic influence in order to reduce the severity of pain in patients after breast augmentation. ***Materials and methods.*** The study is based on the results of a survey of 89 females who underwent breast replacement with silicone implants. All women were divided into 4 groups, taking into account the approach to the use of botulinum toxin type A and an electromagnetic field with a frequency of 448 kHz. During the observation, the intensity of the pain syndrome was assessed intraoperatively, as well as in the early and late postoperative periods. ***Results of the study.*** It was found that a course of electrophysiological effects with INDIBA, carried out in the first week after aesthetic endoprosthetics of the mammary glands, significantly increases the effectiveness of the analgesic effect of botulinum toxin. The frequency and severity of mild pain in this subgroup of patients on days 1 and 2 is less by 51.7% ($p < 0.01$) and 41.8% ($p < 0.01$) compared to the results using only botulinum toxin. Statistical calculations revealed a strong connection between the course of use of the electrophysiological effect of INDIBA after the administration of botulinum toxin with the severity of pain on the 1st, 2nd and 7th day of the rehabilitation period after breast replacement ($p < 0,01$). ***Conclusion.*** The proposed set of rehabilitation measures after aesthetic endoprosthetics of the mammary glands has a statistically significant, pathogenetically substantiated, pronounced and long-lasting analgesic effect in the postoperative period.

Keywords: mammary gland augmentation, endoprosthetics, pain syndrome, butolotoxin, electrophysiological effect

ПАТОГЕНЕТИЧЕСКОЕ ОБОСНОВАНИЕ ФИЗИОТЕРАПЕВТИЧЕСКИХ МЕТОДИК ОБЕЗБОЛИВАНИЯ ПОСЛЕ ЭНДОПРОТЕЗИРОВАНИЯ МОЛОЧНЫХ ЖЕЛЕЗ

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Резюме. ***Введение.*** Аугментация молочных желез является наиболее частым эстетическим хирургическим вмешательством. Однако эндопротезирование с использованием силиконовых имплантов зачастую сопровождается рядом негативных последствий в послеоперационном периоде, связанных в том числе с выраженным болевым синдромом. Одним из возможных путей решения данной проблемы является внутримышечное введение ботулотоксина с последующим использованием электромагнитного воздействия в области эндопротезирования. ***Цель исследования*** — оценить эффективность комбинированного применения внутримышечного введения ботулотоксина с последующим использованием электромагнитного воздействия с целью снижения выраженности болевого синдрома у пациенток после аугментации молочных желез. ***Материалы и методы.*** Исследование основано на результатах обследования 89 лиц женского пола, перенесших эндопротезирование молочных желез силиконовыми имплантами. Все женщины были разделены на 4 группы с учетом подхода к использованию ботулотоксина типа А и электромагнитного поля с частотой 448 кГЦ. В ходе наблюдения оценивали интенсивность болевого синдрома интраоперационно, а также в раннем и позднем послеоперационных периодах. ***Результаты исследования.*** Установлено, что курс электрофизиологического воздействия препаратом INDIBA, проводимый в первую неделю после эстетического эндопротезирования молочных желез, существенно повышает эффективность обезболивающего действия ботулотоксина. Частота и выраженность легкого болевого синдрома в этой подгруппе пациенток на 1-е и 2-е сутки оказывается меньше на 51,7% ($p < 0,01$) и на 41,8% ($p < 0,01$) по сравнению с результатами использования лишь ботулотоксина. Статистический расчет позволил выявить сильную связь между курсовым использованием электрофизиологического воздействия INDIBA после введения ботулотоксина с выраженностью болевого синдрома на 1-е, 2-е и 7-е сутки реабилитационного периода после эндопротезирования молочных желез ($p < 0,01$). ***Заключение.*** Предложенный комплекс реабилитационных мероприятий после эстетического эндопротезирования молочных желез оказывает статистически значимый патогенетически обоснованный выраженный и длительный обезболивающий эффект в послеоперационном периоде.

Ключевые слова: аугментация молочных желез, эндопротезирование, болевой синдром, ботулотоксин, электрофизиологическое воздействие

NTRODUCTION

Surgery involving the placement of silicone implants in breast and mammary gland tissues in order to increase their volume and improve shape is considered one of the most frequently performed by plastic surgeons [9]. Medical devices in the form of silicone gel-filled breast implants have become a routine practice for surgeons and are currently most often used in women for augmentation mammoplasty [13].

There is accumulating evidence that breast endoprosthetics with silicone implants is associated with a number of negative consequences in the postoperative period, up to the development of complications [4].

There is also information that in the postoperative period after breast augmentation using silicone implants,

women experience the pain of varying severity, which is related to the volume of implants placed and patients' age. It is natural that clinical manifestations of pain after breast surgery are accompanied by fear, feeling of shortness of breath, inability to breathe deeply, dyspnea, tachycardia, increased blood pressure, and various vegetative symptoms [3].

Pain syndrome is a typical companion of the postoperative period after breast augmentation. Its manifestations significantly impair the quality of life and reduce the positive perception of even an excellent aesthetic effect, and satisfaction of women after this type of intervention [14].

In a focused assessment of the intensity and severity of pain in postoperative period after various breast surgeries, it was found that after reduction mammoplasty and classical mastectomy, their frequency corresponds to 20 and 30%, respectively. In cases of mastectomy with subsequent reconstruction using an implant, prevalence of pain was up to 52% of observations [1].

Direct trauma to nerve trunks (during tissue incisions, application of nodal sutures) localized in immediate vicinity of the operating field, taking into account the surgical access, leads to postoperative breast pain. Such pain can also be caused by secondary trauma to nerve trunks during the formation of edema, inflammatory reaction in the area of intervention. As a result, persistent pain syndrome occurs in the zone of corresponding innervation within 1–7 days after surgery [10, 15].

In-depth studies have shown that intense acute pain after breast surgery and implant placement is an obligatory factor in the development of chronic pain in postoperative period [11, 12]. To prevent such a vicious path and reduce acute pain after mammoplasty, it is advisable to use the entire arsenal of pain relief methods during this period [2, 7].

The development of pain syndrome in postoperative period after augmentation mammoplasty is detected in two out of three women who underwent the intervention. In this case, pain significantly reduces the quality of life of convalescents and their satisfaction with the operation. Obviously, measures aimed at reducing pain intensity have a pathogenetic focus and are very important in the list of rehabilitation activities.

After aesthetic endoprosthetics of mammary glands with silicone implants, the aim of rehabilitation measures is recognized as the fastest possible labor and social adaptation, improving the quality of life of convalescents.

An important role in the list of methods and techniques of rehabilitation after surgical endoprosthetics of mammary glands belongs to complete analgesia and complete pain relief in postoperative period after such breast surgeries [2]. It is comprehensive postoperative analgesia that stops the typical pathological process — stress response to surgical trauma. As a result, this significantly reduces the incidence of inflammatory complications, hematomas and seromas, respiratory disorders and other complications. Listed pathological conditions substantially impair the quality of life and satisfaction with aesthetic intervention performed.

In order to provide rehabilitation activities in postoperative period, prevention and relief of pain syndrome after breast augmentation with silicone implants, it is advisable to use physiotherapy techniques, in particular microcurrent. It has been shown that microcurrent therapy improves intracellular processes, has an anti-inflammatory effect, normalizes hydrobalance, increases the synthesis and accumulation of macroergic compounds. This is explained by the fact that pain in the area where surgical operation was performed is mediated by the development of an inflammatory reaction. In ideal conditions, this is a sterile aseptic inflammation caused by inevitable destruction of cellular compartments and membranes. It is these products containing arachidonic acid and its phospholipid metabolites, along with mediators of inflammation, that lead to an inevitable inflammatory reaction, edema and typical microcirculation disorders. Microcurrent therapy in these cases has a pronounced pathogenetic significance, exerting an anti-inflammatory effect, stopping microcirculation disorders in tissues in the area of surgery performed [5, 6].

In recent years, electromagnetic field exposure to 448 kHz electric stimulus has been proposed for accelerated relief of inflammatory tissue changes and pain syndrome in postoperative period. It activates ion exchange, as a result of which natural regenerative processes in cells proceed much more effectively. Such physiotherapeutic devices ensure restoration of electrical potential of the cell membrane in postoperative period, improve its permeability, activate collagen production, improve microcirculation and tissue trophism, have anti-edematous effect, promote the reorganization of hematoma areas, as well as stem cell proliferation [8]. These properties seem to be very important for achieving the aims of rehabilitation after breast endoprosthetics and need to be studied.

AIM

The aim of the study is to evaluate the effectiveness of the combined use of intramuscular botulinum toxin injections followed by use of electromagnetic field therapy in order to reduce the severity of pain in patients after breast augmentation.

MATERIALS AND METHODS

The scientific work within the framework of this thesis is planned and completed in the period 2023–2024 at the Department of Surgical Diseases No. 2 of the Faculty of Medicine of the Samarkand State Medical University.

Collection of material for the formation of clinical observation groups was carried out in the period 2021–2024 in the plastic surgery department of the Relax Med Servis clinic, Samarkand, Republic of Uzbekistan.

Observation groups included 89 females who underwent aesthetic endoprosthetics of mammary glands with silicone implants.

Conditions (criteria) for inclusion in this study were: age from 25 to 50 years, presence of clinically significant hypomastia, breast asymmetry, no previous operations in chest and mammary glands area. Voluntary consent of the patient to participate in a scientific study to assess the effectiveness of rehabilitation measures in postoperative period was also required.

Conditions (criteria) for exclusion from the study were: age under 25 and over 50 years, presence of chronic infectious diseases, as well as their exacerbation, coronary heart disease, chronic obstructive pulmonary diseases, respiratory failure of any type, skin infectious and noncommunicable diseases in chest area, hyper- and hypocoagulability, HIV, history of hepatitis B, C, tuberculosis, pregnancy at any stage, lactation, use of pacemakers, thrombophlebitis. Also excluded from the study were patients who signed refusal to voluntarily to participate in a scientific study to assess the effectiveness of rehabilitation measures in postoperative period.

The group of clinical observations No. 1 included 23 women (25.8%) who underwent breast endoprosthetics with silicone implants. They were administered botulinum toxin type A into *musculus pectoralis major* 14 days before intervention to achieve its denervation and prevent pain syndrome after surgery.

The group of clinical observations No. 2 included 24 females (26.9%) who also underwent breast augmentation using silicone implants. They were administered botulinum toxin type A into *musculus pectoralis major* 14 days before intervention to achieve its denervation and prevent pain. Moreover, in this group, during the 1, 2, 3, 4, 5, 6, and 7th days of postoperative period, additional physiotherapeutic treatment was performed. It was carried out using INDIBA — a device that has an electromagnetic field with a frequency of 448 kHz.

The group of clinical observations No. 3 included 22 women (24.7%) who also underwent endoprosthetics of mammary glands with silicone implants. They were administered equivalent volume of placebo (0.9% sodium chloride solution) into *musculus pectoralis major* 14 days before intervention. Also, in the period of 1, 2, 3, 4, 5, 6, 7th days of postoperative period they underwent physiotherapy with the INDIBA — an electromagnetic field with a frequency of 448 kHz.

The group of clinical observations No. 4 included 20 females (22.4%) who also underwent breast augmentation with silicone implants. They were administered equivalent volume of placebo (0.9% sodium chloride solution) into *musculus pectoralis major* 14 days before surgery. Physiotherapeutic treatment with the INDIBA — an electromagnetic field with a frequency of 448 kHz was not performed for organizational reasons.

The group of clinical observations No. 1 was considered control.

In order to achieve denervation and immobilization of *musculus pectoralis major* and reduce the intensity of pain, botulinum toxin type A “Botox” was administered at 200 U (100 U on the right and left) at a concentration of 1:25 (1 ml of the drug in 25 ml of 0.9% sodium chloride) no more than 2.5 ml at one injection point (according to Ermilova E.V. et al., 2022). It was administered in the early stages after augmentation of mammary glands 14 days before intervention to patients of the 1st and 2nd groups (a total of 47 observations) intramuscularly into specified muscle, in ten conditional sectors of muscle corresponding to injection points. Patients in groups 3 and 4 (42 observations in total) were administered equivalent volume of placebo (0.9% sodium chloride) according to the same regimen.

During postoperative period, patients of the 3rd and 4th groups (42 observations in total) underwent physiotherapeutic treatment with the INDIBA active 801 (Spain) for accelerated rehabilitation and tissue restoration. It is aimed to affect the skin and muscle fibers. It is recommended for working with superficial tissues abundantly supplied with vessels. Device ensures recovery of membrane potential, improvement of membrane permeability, restoration and maintenance of normal cellular physiology, activation of collagen production, improvement of microcirculation and tissue trophism. The use of appliance had three contraindications: pregnancy, use of pacemakers, thrombophlebitis, which were included in exclusion criteria.

The mode of operation of device used in women in postoperative period after breast endoprosthetics provides exposure to the method of radio frequency cellular electrotherapy at a frequency of 448 kHz. It was used in the first week after surgery, daily, on chest area, exposure was 15 minutes.

After surgery, in the first week daily, in the second week every other day, as well as on the 15th and 30th day, and 3, 6, 9, 12 months later during control check-ups and examinations, general condition of convalescents, intensity of pain,

presence and severity of respiratory disorders, possibility of activation, ability to work and performance were analyzed.

In order to assess the intensity of pain syndrome intraoperatively (anamnestically) and in postoperative period at 1, 2, 3, 7, 14 days, 1, 3 and 6 months after intervention, a questionnaire of the Numeric Pain Rating Scale (Numeric Pain Scale) was used. It was proposed by McCaffery M. and Beebe A. in 1993, and allowed to assess the intensity of pain sensations from 0 to 10 scores. The score of 1–3 was considered as a mild pain syndrome (unpleasant pain sensations), 4–6 were considered as a moderate syndrome (moderate pain); 7–10 scores corresponded to a high degree of pain syndrome, severe pain.

The results obtained were processed by generally accepted methods of variation statistics.

RESULTS AND DISCUSSION

The intensity of pain syndrome in analyzed subgroups, as well as in the control subgroup of patients during the month after aesthetic endoprosthetics of mammary glands with silicone implants is shown in Table 1. The data of the table allow us to conclude that among the subgroup of women in whom administration of botulinum toxin type A was combined with the course of electrophysiological effect, by the end of the first day of postoperative period, pain syndrome of mild and moderate severity prevailed — in 76.4 and 11.3% of observations. Simultaneously, during the same period, among patients who received only botulinum toxin, frequency of mild and moderate pain syndrome was 51.7% lower ($p < 0.01$) and 25.4% higher ($p < 0.05$), respectively. In the control group, where botulinum toxin was not administered, there was no electrophysiological exposure, and severe and moderate pain syndrome predominated — in 45.7 and 36.8% of clinical observations, respectively (Table 1).

In the meantime, in the same array of clinical observations, on the 2nd day after aesthetic breast endoprosthetics, in the subgroup of observations where rehabilitation measures included the introduction of botulinum toxin and electrophysiological effects, absence of pain syndrome was recorded in 11.3% of cases. Moreover, pain of mild or moderate intensity was observed in 74.5 and 11.1% of patients, respectively. Within the same period, in the comparison group, where only botulinum toxin was used, frequency of mild pain syndrome was 41.8% lower ($p < 0.01$), and moderate pain was 28.2% higher ($p < 0.05$). As on the first day, by the end of the second day in the control group, where only placebo was used without electrophysiological exposure, severe and moderate pain syndromes prevailed — in 32.6 and 43.6% of cases, respectively.

One week after surgery, pain syndrome in analyzed group of patients, whose rehabilitation activities included administration of botulinum toxin and course of electrophysiological treatment, was practically absent — 78.2% of observations. Low intensity was found in 21.8% of cases. During the same period, in the subgroup of patients who received only botulinum toxin before surgery, cases of absence of pain syndrome were detected 21.9% less frequently ($p < 0.05$). Moreover, in 6.1% of cases, pain syndrome of moderate intensity was noted.

By the end of the second and fourth weeks of postoperative period, in the subgroup of women who received botulinum toxin preparation and course of electrophysiological treatment, complete absence of pain syndrome was noted in 89.2 and 94.5% of cases, respectively. This was 10.7 and 9.1% ($p > 0.05$) more, respectively, than in the same periods in the subgroup of females who received only botulinum toxin. Statistical differences in frequency and severity of mild pain syndrome in these two subgroups of patients on the 14th and 30th days after surgery also reached 10.7% (parameter values 21.5 and 10.8%) and 9.4% (parameter values 14.9 and 5.5%), respectively. However, differences were also statistically insignificant ($p > 0.05$).

The results of conducted studies lead to the conclusion that course of electrophysiological treatment using INDIBA, carried out daily during the first week, i.e. seven procedures after aesthetic endoprosthetics of mammary glands, significantly increases the effectiveness of analgesic effect of administration of botulinum toxin type A 14 days before surgery. It was found that with their combined use, frequency and severity of mild pain syndrome on the 1st and 2nd days are lower by 51.7% ($p < 0.01$) and 41.8% ($p < 0.01$), respectively, compared to results of using botulinum toxin alone.

Pathogenetically conditioned factor providing anti-inflammatory and analgesic action, early rehabilitation is electrophysiological effect of electromagnetic field of the INDIBA used by us. It was found that among women in whom administration of botulinum toxin was combined with the course of electrophysiological exposure, by the end of the first day, pain syndrome of mild and moderate intensity prevailed — in 76.4 and 11.3% of observations. On the second day after aesthetic breast endoprosthetics in the same array of patients, absence of pain syndrome was noted in 11.3% of cases. At the same time, pain of mild or moderate intensity was detected in 74.5 and 11.1% of patients, respectively.

After a week, in analyzed group of patients, whose rehabilitation measures included administration of botulinum toxin and course of electrophysiological treatment, pain was practically absent in 78.2% of observations. In addition, mild pain syndrome was detected in 21.8% of cases. By the end of the second and fourth weeks of postoperative period, in the subgroup of women who received botulinum toxin

Table 1

Dynamics of pain after breast augmentation, taking into account electrophysiological therapy in the postoperative period

Таблица 1

Динамика болевого синдрома после аугментации груди с учетом электрофизиологической терапии в послеоперационном периоде

Срок, сут. Duration, days	Курс процедур INDIBA / INDIBA treatment course	Частота выявления болевого синдрома, % / Frequency of detection of pain syndrome, %			
		нет / no	легкого / slight	умеренного / moderate	выраженного / severe
1	Есть, без ботулотоксина / Yes, without botulinum toxin	5,8	24,7	36,7	32,8
	Есть, на фоне ботулотоксина / Yes, with botulinum toxin	4,6	76,4	11,3	7,7
	Нет / No	0	17,5	36,8	45,7
2	Есть, без ботулотоксина / Yes, without botulinum toxin	8,9	32,7	39,3	19,1
	Есть, на фоне ботулотоксина / Yes, with botulinum toxin	11,3	74,5	11,1	3,1
	Нет / No	0	23,8	43,6	32,6
7	Есть, без ботулотоксина / Yes, without botulinum toxin	56,3	37,6	6,1	0
	Есть, на фоне ботулотоксина / Yes, with botulinum toxin	78,2	21,8	0	0
	Нет / No	34,7	38,4	26,9	0
14	Есть, без ботулотоксина / Yes, without botulinum toxin	78,5	21,5	0	0
	Есть, на фоне ботулотоксина / Yes, with botulinum toxin	89,2	10,8	0	0
	Нет / No	61,2	38,8	0	0
30	Есть, без ботулотоксина / Yes, without botulinum toxin	85,1	14,9	0	0
	Есть, на фоне ботулотоксина / Yes, with botulinum toxin	94,5	5,5	0	0
	Нет / No	67,9	32,1	0	0

preparation and course of electrophysiological exposure, complete absence of pain syndrome was noted in 89.2 and 94.5% of cases, respectively.

The results of the conducted studies lead to the conclusion that the course of electrophysiological treatment using INDIBA, carried out in the first week after aesthetic endoprosthetics of mammary glands, significantly increases the effectiveness of analgesic action of botulinum toxin. When combining these methods, frequency and severity of mild pain on the 1st and 2nd day are lower by 51.7% ($p < 0.01$) and by 41.8% ($p < 0.01$) compared to results of using only botulinum toxin. Statistical calculation revealed a strong connection between course use of electrophysiological treatment with INDIBA after administration of botulinum toxin with the severity of pain on the 1st, 2nd and 7th days of rehabilitation period after breast augmentation using silicone implants ($p < 0.01$).

FINDINGS

1. Adequate analgesia in the early and late postoperative periods after breast endoprosthetics is the main task of aesthetic surgery, ensuring the fastest possible labor and social adaptation of patients.

2. When combining the injection of botulinum toxin and the electromagnetic field expusure of INDIBA, the intensity of the pain syndrome during the first month of observation in more than 90% of cases was mild. This indicates complete denervation of musculus pectoralis major, accompanied by pronounced analgesic effect.

CONCLUSION

Thus, presented results of the study of methods for reducing the severity of pain in patients after aesthetic endoprosthetics of mammary glands turned out to be convincing. The proposed set of rehabilitation measures after surgery in the form of parenteral intramuscular administration of botulinum toxin with course of electrophysiological exposure to an electromagnetic field has a pronounced and long-term analgesic effect in postoperative period.

ADDITIONAL INFORMATION

Author contribution. Thereby, all authors made a substantial contribution to the conception of the study, acquisition, analysis, interpretation of data for the work, drafting and revising the article, final approval of the version to be published and agree to be accountable for all aspects of the study.

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REFERENCES

1. Manturova N.E., Karasev V.E., Ismagilov A.H. Bolevoj sindrom posle operativnogo lecheniya raka molochnoj zhelezy. [Pain syndrome after surgical treatment of breast cancer]. Plasticheskaya hirurgiya i esteticheskaya medicina. 2022; 4: 35–40. (in Russian).
2. Ovechkin A.M., Zvizhuleva A.A. Posleoperacionnoe obezbolivanie v plasticheskoj hirurgii. [Postoperative pain relief in plastic surgery]. Regional'naya anesteziya i lechenie ostroj boli. 2016; 10(2): 82–96. (in Russian).
3. Odinak M.M., Zhivolupov S.A., Samarcev I.N. Bolevye sindromy v nevrologicheskoj praktike. [Pain syndromes in neurological practice]. Zhurnal nevrologii i psihiatrii. 2009; 9: 80–9. (in Russian).
4. Shcherbinina E.P., Olifrienko K.M., Gordova V.S. Grudnye silikonovye implantaty: k voprosu o posleoperacionnyh oslozhneniyah. [Breast silicone implants: on the issue of postoperative complications]. Vestnik Baltijskogo federal'nogo universiteta im. I. Kanta. Ser.: Estestvennye i medicinskie nauki. 2020; 3: 89–9. (in Russian).
5. Fujiya H., Ogura Y., Ohno Y. Microcurrent electrical neuromuscular stimulation facilitates regeneration of injured skeletal muscle in mice. J. Sports Sci. Med. 2015; 2; 297–303. (in Russian).
6. Gabriel A., Sobota R., Gialich S. The use of Targeted MicroCurrent Therapy in postoperative pain management. Plast. Surg. Nurs. 2013; 33(1): 6–8.
7. Gerbeshagen H., Aduckath S. Pain intensity on the first day after surgery. Anesthesiology. 2013; 118: 934–44.
8. Hernández-Bule M.L., Paíno C.L., Trillo M.Á., Úbed A. Electric stimulation at 448 kHz promotes proliferation of human mesenchymal stem cells. Cell Physiol. Biochem. 2014; 34(5): 1741–55.
9. Johnson M. Breast implants: history, safety, and imaging. Radiol Technol. 2013; 84: 439–515.
10. Linderoth G., Kehlet H., Aasvang E.K. Neurophysiological characterization of persistent pain after laparoscopic inguinal hernia repair. Hernia. 2011; 15: 521–9.
11. Macrae W. Chronic post-surgical pain: 10 years on. Br. J. Anaesth. 2008; 101: 77–86.
12. Poleshuck E.L., Katz J., Andrus C.H. Risk factors for chronic pain following breast cancer surgery: a prospective study. Pain. 2006; 7: 626–34.
13. Siggelkow W., Faridi A., Spiritus K. Histological analysis of silicone breast implant capsules and correlation with capsular contracture. Biomaterials. 2003; 24: 1101–9.
14. Sperling M.L., Hoimyr H., Finnerup K. Persistent pain and sensory changes following cosmetic breast augmentation. Eur. J. Pain. 2011; 15: 328–32.
15. Werner M.U., Kongsgaard U.E. Defining persistent post-surgical pain: is an update required? BJA J. 2014; 113(1): 1–4.

ЛИТЕРАТУРА

1. Мантурова Н.Е., Карасев В.Е., Исмагилов А.Х. Болевой синдром после оперативного лечения рака молочной железы. Пластическая хирургия и эстетическая медицина. 2022; 4: 35-40.
2. Овечкин А.М., Звижулева А.А. Послеоперационное обезболивание в пластической хирургии. Региональная анестезия и лечение острой боли. 2016; 10(2): 82–96.

3. Одинак М.М., Живолупов С.А., Самарцев И.Н. Болевые синдромы в неврологической практике. Журнал неврологии и психиатрии. 2009; 9: 80–9.
4. Щербинина Е.П., Олифриенко К.М., Гордова В.С. Грудные силиконовые имплантаты: к вопросу о послеоперационных осложнениях. Вестник Балтийского федерального университета им. И. Канта. Сер.: Естественные и медицинские науки. 2020; 3: 89–99.
5. Fujiya H., Ogura Y., Ohno Y. Microcurrent electrical neuromuscular stimulation facilitates regeneration of injured skeletal muscle in mice. J. Sports Sci. Med. 2015; 2; 297–303.
6. Gabriel A., Sobota R., Gialich S. The use of Targeted MicroCurrent Therapy in postoperative pain management. Plast. Surg. Nurs. 2013; 33(1): 6–8.
7. Gerbeshagen H., Aduckath S. Pain intensity on the first day after surgery. Anesthesiology. 2013; 118: 934–44.
8. Hernández-Bule M.L., Paíno C.L., Trillo M.Á., Úbed A. Electric stimulation at 448 kHz promotes proliferation of human mesenchymal stem cells. Cell Physiol. Biochem. 2014; 34(5): 1741–55.
9. Johnson M. Breast implants: history, safety, and imaging. Radiol Technol. 2013; 84: 439–515.
10. Linderoth G., Kehlet H., Aasvang E.K. Neurophysiological characterization of persistent pain after laparoscopic inguinal hernia repair. Hernia. 2011; 15: 521–9.
11. Macrae W. Chronic post-surgical pain: 10 years on. Br. J. Anaesth. 2008; 101: 77–86.
12. Poleshuck E.L., Katz J., Andrus C.H. Risk factors for chronic pain following breast cancer surgery: a prospective study. Pain. 2006; 7: 626–34.
13. Siggelkow W., Faridi A., Spiritus K. Histological analysis of silicone breast implant capsules and correlation with capsular contracture. Biomaterials. 2003; 24: 1101–9.
14. Sperling M.L., Hoimyr H., Finnerup K. Persistent pain and sensory changes following cosmetic breast augmentation. Eur. J. Pain. 2011; 15: 328–32.
15. Werner M.U., Kongsgaard U.E. Defining persistent post-surgical pain: is an update required? BJA J. 2014; 113(1): 1–4.