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SUBSTANTIATION OF THE APPLICATION OF GASLESS LAPAROSCOPIC CHOLECYSTECTOMY IN PATIENTS WITH A BACKGROUND OF COVID-19 RESPIRATORY INFECTION

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During the COVID-19 pandemic, calculous cholecystitis is one of the most frequent emergency pathologies requiring immediate surgical intervention. Laparoscopic surgery around the world has successfully replaced open surgery. However, high intra-abdominal pressure of carbon dioxide, which is used according to the technology, leads to a high level of standing diaphragm, and can exert an extremely negative influence at the end of the operation in patients with COVID-19 respiratory infection. One of the ways to prevent complications is the further development of the laparolifting gasless laparoscopy technique. The aim of the study was to improve the surgical treatment of patients with acute calculous cholecystitis against the background of COVID-19 infection. We conducted an analysis of the effectiveness of cholecystectomies using the pneumoperitoneum and gasless method with the help of the laparolifting device, which we developed. The study involved the observation of patients who were immediately admitted to the surgical department with acute calculous cholecystitis against a background of COVID-19. The study showed that conducting cholecystectomy with the use of laparolifting in patients with COVID-19 respiratory infection allows us to reduce the risk of perioperative complications from the lungs, overstrain of the cardiovascular system and reduce the need for oxygen after surgery in patients with respiratory disorders, as well as to reduce the risk of increased blood pressure, eliminate the imbalance of the coagulation system in patients with COVID-19 infection much faster and restore the enzymatic activity of the liver in patients after surgery.

Keywords: COVID-19, calculous cholecystitis, laparoscopic cholecystectomy, laparolifting.

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ОБҐРУНТУВАННЯ ЗАСТОСУВАННЯ «БЕЗГАЗОВОЇ ЛАПАРОСКОПІЧНОЇ» ХОЛЕЦИСТЕКТОМІЇ У ХВОРИХ НА ФОНІ COVID-19 РЕСПІРАТОРНОЇ ІНФЕКЦІЇ

У період пандемії COVID-19 однією з найчастіших екстрених патологій, що потребують хірургічного втручання, виявився калькульозний холецистит. Лапароскопічна хірургія у всьому світі успішно замінила відкриту хірургію, однак, високий інтраабдомінальний тиск вуглекислого газу при карбоксиперетонеумі може негативно позначитися наприкінці операції у хворих на COVID-19. Одним із способів запобігання ускладнень є подальший розвиток техніки «безгазової лапароскопії». Метою дослідження було удосконалити хірургічне лікування пацієнтів з гострим калькульозним холециститом, на тлі COVID-19. Проведено аналіз ефективності холецистектомій, виконаних з використанням пневмоперитонеуму та лапароліфтингу. Спостереження проводилися за пацієнтами, які негайно надійшли до хірургічного відділення з приводу гострого калькульозного холециститу на тлі COVID-19. Дослідження показало, що холецистектомія із застосуванням лапароліфтингу у пацієнтів з COVID-19 дозволяє знизити ризик розвитку периопераційних ускладнень з боку легень, перенапружити серцево-судинної системи і зменшити потребу у кисні після операції пацієнтів с респіраторними розладами, а також знизити ризик підвищення артеріального тиску, значно швидше усунути дисбаланс з боку системи згортання у пацієнтів з COVID-19 і відновити ферментативну активність печінки у пацієнтів після операції.

Ключові слова: COVID-19, калькульозний холецистит, лапароскопічна холецистектомія, лапароліфтинг.

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The COVID-19 pandemic has led to a paradigm shift in the treatment of various surgical diseases of the gastrointestinal tract. The exponential increase in the number of patients affected by COVID-19 has led to an unprecedented crisis in medical institutions [2]. The data that appeared indicated high surgical mortality and many postoperative complications in surgical patients with various stages of coronavirus infection [1]. Limited healthcare resources, such as personal protective equipment, and intensive care units, have forced surgical departments around the world to reschedule their operations, postponing scheduled cases and performing only emergency vital procedures [3].

Acute calculous cholecystitis both before the pandemic and during the pandemic is one of the most common surgical pathologies [4]. The prevalence of gallstone disease in the adult population both in Ukraine and throughout the world has a steady upward trend [5, 6]. The operations of choice in the treatment of emergency conditions in the abdominal cavity, especially cholecystectomy, are endovideosurgical interventions. The low level of operative trauma and complications, and the pace of postoperative recovery and rehabilitation form the unconditional advantages of laparoscopic surgery, therefore, laparoscopic surgery has successfully replaced open surgery [7, 8].

However, according to the technology, the operation requires a rather high intra-abdominal pressure of carbon dioxide (CO₂), which leads to mechanical stretching and a high level of the standing of the diaphragm, which, if a patient has pneumonia, can have an extremely negative effect at the end of the operation. In patients with reduced reserves of the cardiovascular and respiratory systems, it can lead to disruption of the body's adaptive reactions and the development of intra- and postoperative complications [9]. One of the ways to prevent complications associated with the creation of a tense carboxyperitoneum is the further development of the technique of gasless laparoscopy using various means of the mechanical lifting of the anterior abdominal wall against the background of epidural anesthesia. The method of gasless laparoscopy prevents or minimizes the disadvantages and complications of endoscopic operations with CO₂ while preserving all the advantages of laparoscopy [10].

The use of gasless laparoscopy and laparolifting techniques opens up broad prospects for performing laparoscopic interventions in patients with pneumonia against the background of COVID-19 infection. Therefore, conducting research on improving the techniques of gasless laparoscopy and laparolifting, which improve visualization in the operative site, increase the safety profile and allow us to significantly reduce the risk of perioperative complications in patients with both COVID-19 pneumonia and cardiopulmonary failure is relevant and timely.

The purpose of the study was to improve surgical treatment of patients with acute calculous cholecystitis against the background of COVID-19 infection who require videoendoscopic (laparoscopic) interventions, by developing personalized therapy taking into account possible respiratory complications with the help of the laparolifting device, which we improved.

Materials and methods: We conducted an analysis of the efficacy of cholecystectomies performed using pneumoperitoneum with the help of CO₂ insufflation and gasless method with the help of the laparolifting device, which we developed ("laparolifting device", patent No. 151309 as of 29.06.2022, bulletin No. 26) Our device for laparolifting has a rod with horizontal and vertical parts curved in mutually perpendicular planes, made of stainless medical steel and the possibility of mounting on a lifting and fixing bracket. The horizontal part of the rod is bent in an arc with a radius of 73.5 mm in the horizontal plane and cut in half lengthwise. At the end of the vertical part of the rod, a thread is made, on which a threaded knot is wound. A cylindrical coupling freely moves on the lifting-fixing bracket, which has central threaded holes on both sides, into one of which a threaded assembly is screwed, and into the other – a stopper for fixing the position of the cylindrical coupling on the bracket (Fig. 1).



Fig. 1. Laparolifting device.

The study involved the observation of patients who were immediately admitted to the surgical department with acute calculous cholecystitis against a background of COVID-19 respiratory infection. Patients were divided into 2 groups. The main group included 26 patients who underwent laparoscopic cholecystectomy without the use of pneumoperitoneum and using the laparolift, which we developed. The comparison group included 15 patients who underwent cholecystectomy in a standard way with the use of pneumoperitoneum. All patients were diagnosed with COVID-19 infection by PCR analysis of nasopharyngeal mucus. The operations were performed in the inpatient conditions at the clinical base of the Department of Surgery No. 4 of Poltava State Medical University (Poltava, Ukraine). In terms of sex and body-build characteristics, age, anesthetic risk, and comorbidity index, the studied groups were representative.

Statistical processing of the obtained data was carried out using the software "Excel" and "GraphPad Prism 5.0". Descriptive statistics is presented as mean \pm standard error of the mean ($M \pm m$). Quantitative values are presented in the form of median (Me), and qualitative indicators are presented in the form of percentages (%). Differences in relative values (%) were determined by the phi-Fisher angular transformation method. Student's t-test was used to assess intergroup differences. Differences were considered statistically significant at $p < 0.05$.

Results of the study and their discussion. Observational analysis showed that as a result of endovideolaparoscopic cholecystectomy with the laparolifting device, which we developed (Fig. 1), patients with COVID-19 respiratory infection had significantly fewer complications (7.6 % vs. 33.3 %, respectively, $p < 0.05$), and the duration of inpatient treatment was significantly shorter compared to patients who underwent pneumoperitoneum (4.17 ± 0.47 k/d vs. 6.06 ± 0.84 k/d, respectively, $p < 0.05$).

A comparative analysis of the dynamics of changes in hemodynamic indicators, such as mean arterial pressure (MAP, mm Hg), heart rate (HR, bpm), blood pH and oxygen saturation (SpO₂ %) in the blood of patients in the observed groups showed that patients in both groups were hemodynamically compensated before surgery. However, after CO₂ insufflation in the comparison group, the studied

parameters changed significantly, so patients of this group had a significant increase in MAP (128.3 ± 2.41 mm Hg vs. 110.21 ± 2.16 mm Hg before insufflation, $p < 0.05$), and heart rate (110.24 ± 2.12 beats/min, against 90.23 ± 2.12 beats/min before insufflation, $p < 0.05$). Heart rate indicators did not recover even 30 minutes after CO₂ insufflation. A decrease in O₂ tension in the blood was also noted, both after CO₂ injection into the abdominal cavity and 30 minutes after (SpO₂ before insufflation 98.84 ± 0.76 %, after insufflation 96.12 ± 1.13 %, 30 minutes after insufflation 95.21 ± 1.32 %, $p < 0.05$).

In the main group of patients, after the introduction of laparolifting, an increase in hemodynamic indices was also observed, but the indices were significantly lower, so the MAP indicator was 118.3 ± 2.41 mm Hg against 128.3 ± 2.41 mm Hg in patients of the comparison group ($p < 0.05$), heart rate 102.14 ± 2.13 bpm versus 110.24 ± 2.12 bpm, respectively ($p < 0.05$), but after 30 minutes all indicators returned to normal values. Changes in blood O₂ saturation and blood pH after the introduction of laparolift did not differ significantly from the values before the operation.

The assessment of ventilation parameters during surgical intervention showed that in patients of the comparison group who underwent traditional laparoscopic cholecystectomy, the peak pressure in the respiratory tract (P_{peak}) was 35 ± 2.4 mmHg, against 30 ± 2.3 mm H₂O in patients of the main group who underwent laparolifting ($p > 0.05$). The increase in peak pressure indices in patients of the comparison group was due to both the presence of gas in the abdominal cavity, which puts pressure on the diaphragm, and inflammatory changes in the lungs during COVID-19, which reduce the ability of lung tissue to stretch. At the same time, the respiratory volume was 600 ± 98 ml in the patients of the main group, in whom we used laparolifting, against 590 ± 90 ml, which may indicate that when reducing the external gas pressure on the diaphragm, it is possible to increase lung compliance and improve ventilation indicators.

When analyzing the need for oxygen (in l/min) to achieve a saturation of 95 % on the 1st day after surgery in both groups, it increased and amounted to 8.1 ± 0.3 l/min in the main group, and 8.4 ± 0.4 l/min in the comparison group ($p < 0.05$). On the 2nd day, the increased need remained in the comparison group (8.0 ± 0.4 l/min), and in the main group, it decreased to 7.1 ± 0.5 l/min. ($p > 0.05$). On the 3rd day, a further decrease in oxygen demand was observed, which was more pronounced in patients of the main group (6.3 ± 0.4 l/min) compared to patients in the comparison group (7.3 ± 0.4 l/min), $p > 0.05$.

The study of hemostasis indices in patients with COVID-19 infection in the perioperative period of cholecystectomy, depending on the use of laparolifting or pneumoperitoneum, showed an increase in the level of fibrinogen in the blood after cholecystectomy in both groups. However, in patients of the group where laparoscopic surgery was performed with the use of pneumoperitoneum, the median of fibrinogen in the blood was significantly higher (5.27 ± 1.17 g/l, median 4.7 vs. 4.31 ± 0.84 g/l, median 4.45, respectively, $p < 0.05$).

One of the basic indices of the coagulogram, which gives an estimate of the effectiveness of the internal blood clotting pathway, is the activated partial thromboplastin time – APTT. This index is able to act as an independent indicative test, which is used in screening analyzes of the hemostasis system.

The level of APTT in the blood before surgery in both groups was not significantly different and was 28.88 ± 1.35 seconds (median 29) in patients of the main group and 29.46 ± 1.47 seconds (median 30) in patients of the control group $p < 0.05$. After the operation, this index in the main group was 27.83 ± 1.35 seconds (median 28) and 26.73 ± 1.57 seconds in the control group (median 26, $p > 0.05$). A decrease in APTT in the coagulogram indicates the prevalence of hypercoagulation. A decrease in this index in our observation was noted after surgery in patients of both groups, however, in the patients of the comparison group, APTT decreased significantly more.

Activated partial thromboplastin time when studying the functioning of the hemocoagulation system is often “coupled” with another important laboratory analysis – PT (prothrombin time), or prothrombin index – PTI, which examines the external pathway of activation. Before surgery, PTI indices in both groups did not differ significantly and were 136.45 ± 23.54 % (median 135) in the main group and 137.87 ± 21.0 % (median 139) in the control group, $p > 0.05$. After surgery, PTI was significantly higher in patients in the control group, where cholecystectomy was performed with the use of carboxyperitoneum (141.98 ± 18.56 , median 140 vs. 148.20 ± 16.71 , median 156, $p < 0.05$).

The international normalized ratio (INR) is the preferred method of choice for diagnosing coagulopathy associated with COVID-19 and predicting clinical outcomes [11]. INR is calculated as the ratio of the patient's prothrombin time (PT) to the control PT, standardized for the activity of the thromboplastin reagent developed by the World Health Organization (WHO). The INR index in patients with COVID-19 infection before cholecystectomy in both groups was not significantly different and was 1.01 ± 0.17 (median 0.94) in patients of the main group and 1.0 ± 0.18 in the comparison group (median 0.97). However, after the operation in the patients of the main group, the INR index decreased to 0.92 ± 0.09 (median 0.83), and in the patients of the comparison group, where pneumoperitoneum was used, the INR remained at the same level – 1.02 ± 0.14 (median 0.96) $p < 0.05$.

Indices of liver enzymes in the blood (AST and ALT) in patients of both groups did not differ in the perioperative period. Before the operation, the level of enzymes in the blood was the same in both groups, after the operation, an increase in the level of enzymes was also noted in both groups. However, on the third day, patients in the main group had a significant decrease in the studied parameters, while in patients in the comparison group, the level of liver enzymes in the blood remained high. Therefore, the restoration of the functional ability of the liver was significantly faster in patients who underwent cholecystectomy with the help of laparolifting.

An analysis of lactate dehydrogenase (LDH) indices in the blood of patients with COVID-19 infection who were admitted to the emergency department for acute cholecystitis showed elevated levels of this enzyme, which is consistent with the reports of a number of studies in patients with COVID-19 [12]. LDH is an enzyme produced by the cells of the human body and involved in glycolysis. It is found in most tissues of the body, but it is most active in the kidneys, liver, erythrocytes and muscular tissue, and its level begins to increase when organs and tissues are damaged. Before surgery, the level of LDH enzyme indices in both groups did not differ significantly, in the postoperative period, the level of LDH in the blood in the main group was significantly lower and amounted to 278.82 ± 32.41 U/l (median 260) against 293.73 ± 47.65 U/l (median 280 $p < 0.05$).

Damage to the pulmonary system in the case of COVID-19 infection causes a number of difficulties in performing the pneumoperitoneum, which can contribute to the development of atelectasis, oxidative stress, disorders of the cardiovascular system, and the development of complications in the postoperative period. Therefore, it is more feasible to use gasless laparoscopic cholecystectomy in patients with COVID-19 infection. [13]. The analysis of clinical and laboratory monitoring of the results of emergency cholecystectomy in patients with COVID-19 infection, depending on the method of laparoscopic cholecystectomy, provided the following results.

As a result of endovideolaparoscopic cholecystectomy with the laparolifting device, which we developed, patients with COVID-19 respiratory infection had significantly fewer complications and the duration of inpatient treatment was significantly shorter, compared to patients who underwent pneumoperitoneum. The increase in MAP and HR in patients with COVID-19 during cholecystectomy with the use of pneumoperitoneum is explained by a significant increase in intra-abdominal pressure, which compresses the diaphragm and limits the excursion of the lungs, which leads to an increase in intrathoracic pressure [14]. At the same time, systemic vascular resistance increases, and compensatory tachycardia develops due to a decrease in stroke volume. The peak pressure in the respiratory tract and intrapleural pressure also increase, which leads to the disruption of the ventilation-perfusion ratio with the development of hypercapnia and acidosis [15]. As a result, SpO₂ decreases, which we recorded in patients of the comparison group after insufflation of carbon dioxide into the abdominal cavity. All this can lead to the development of atelectasis, as venous shunting increases from 1–3 % to 10 % of cardiac output. These pathological phenomena are also potentiated by general anesthesia. With deep anesthesia, the hydrostatic effect (due to the forced increase in blood filling of the lungs) is stronger due to the disruption of compensatory mechanisms of vascular tone regulation [9]. All this made it necessary to increase the flow of oxygen to achieve saturation of 95 % in these patients, and to increase the peak pressure in the respiratory tract.

A decrease in saturation in patients who underwent laparoscopic cholecystectomy with the help of pneumoperitoneum is also explained by the fact that with an increase in intra-abdominal pressure, the processes of gas exchange in the lungs are disturbed and respiratory acidosis develops. The use of CO₂ during laparoscopic operations leads to a decrease in blood pH. In addition, blood acidemia can persist in the early postoperative period, since the resorption of CO₂ leads to tension and exhaustion of the body's buffer systems [15].

Many authors have shown that hypercoagulation is characteristic of COVID infection [11]. In our observation, we also noted an increase in hemostasis indices, which indicate hypercoagulation. At the same time, in the perioperative period, there is a significant deterioration of hemostasis indices in patients of the comparison group, where pneumoperitoneum was used, while the method of gasless laparolifting cholecystectomy allows us to eliminate the imbalance on the part of the coagulation system much faster in patients with COVID-19 infection, compared to patients who underwent cholecystectomy with the use of pneumoperitoneum.

One of the reasons for the delay in the restoration of hemostasis imbalance in laparoscopic surgery using pneumoperitoneum is its side effect, which can be harmful in patients with COVID-19 respiratory infection. It has been proven that carbon dioxide pneumoperitoneum causes respiratory acidosis, probably due to gas absorption [14]. In addition, the scholars found that patients who underwent laparoscopic cholecystectomy with pneumoperitoneum had a high risk of developing deep vein thrombosis. Other authors have also reported that the pneumoperitoneum required for laparoscopic surgery leads to several important hemodynamic changes [13]. During laparoscopic surgery with pneumoperitoneum, cardiac

output is also reduced by up to 30 % due to a reduction in stroke volume, which can increase the negative effect of carbon dioxide on hemostasis.

The analysis of the enzymatic activity of the liver in patients in the perioperative period, depending on the method of fixing the abdominal wall, showed that the level of liver enzymes in the blood of patients of both observed groups increased after surgery. However, among themselves, the indices after the operation were not significantly different in both groups of patients. At the same time, on the third day, recovery of enzyme levels after operative stress was observed faster in the main group, where cholecystectomy was performed with the help of laparolifting.

The enzyme lactate dehydrogenase (LDH) is a reliable marker of general hyperinflammation, which correlates with mortality from COVID-19. The glycolytic enzyme LDH has long been identified as a biomarker of systemic inflammation and is therefore considered an effective prognostic index for general inflammatory conditions [12]. LDH belongs to the class of oxidoreductases and plays an important role in the anaerobic glycolysis pathway, which is why it is present in almost all human cells. It is a stable cytoplasmic enzyme that increases in the blood under conditions of membrane instability. In addition, in some studies, LDH has been identified as a particularly useful marker for the evaluation and prediction of lung diseases associated with inflammation [15]. In the postoperative period, this enzyme was higher in the control group, where cholecystectomy was performed with the use of carboxyperitoneum. Probably, hypoxia and absorption of carbon dioxide in the abdominal cavity affected the level of LDH in the blood of patients in this group.

Analysis of the efficacy of cholecystectomies performed using the device for laparolifting, which we developed, in comparison with the use of carboxyperitoneum showed that the period of inpatient treatment of patients was significantly shorter with laparolifting, complications occurred much less often, the tension of hemodynamic indicators in the perioperative period was also significantly lower.

The use of the laparolift, which we developed, made it possible to prevent the deterioration of hemostasis during cholecystectomy and the development of hypercoagulation after surgery. This was manifested in a significantly lower level of fibrinogen, prothrombin index, and international normalized ratio compared to the indices in patients where pneumoperitoneum was used.

Gasless cholecystectomy using the laparolift, which we developed, in patients with COVID-19 respiratory infection contributed to a faster recovery of the fermentative activity of the liver after surgery.

Conclusion

The method of choice for the treatment of acute calculous cholecystitis in patients with COVID-19 respiratory infection is gasless endovideolaparoscopic cholecystectomy with the use of laparolifting to increase the volume of the abdominal cavity, which contributes to the successful manipulation of the surgeon. Pneumoperitoneum in lung diseases is a less effective method.

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SUPPORTIVE THERAPY OF PATIENTS WITH ATOPIC CHEILITIS

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Currently, it is relevant to substantiate and implement methods of maintenance therapy for patients with atopic cheilitis using various groups of moisturizing agents that have a softening effect, stimulate epithelization processes, and eliminate the negative consequences of the disease. The purpose of the study was to substantiate the maintenance therapy in patients with atopic cheilitis using emollients. The study was based on the results of examination and treatment of 19 patients with atopic cheilitis, 12 (63 %) women and 7 (37 %) men, aged 20–36 years. To conduct a clinical study, patients were divided into two groups: 11 people (58 %) with a mild course of the disease, 8 people (42 %) with an average course of atopic cheilitis. Supportive therapy is a necessary step in the complex treatment of patients with atopic cheilitis. Differentiated use of emollients allows 79 % of patients to obtain positive treatment results on the 10th day. The proposed scheme of maintenance therapy can be recommended for use in therapeutic dentistry. Adherence to the principle of participation in the development of an individual course of treatment for atopic cheilitis helps to increase the patient's compliance and, ultimately, his satisfaction with the treatment. Only such a comprehensive approach will help maintain a relatively high quality of life for patients and improve the prognosis for atopic cheilitis.

Key words: atopy, red rim of the lips, emollients.

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ПІДТРИМУВАЛЬНА ТЕРАПІЯ ПАЦІЄНТІВ З АТОПІЧНИМ ХЕЙЛІТОМ

На даний час актуальним є обґрунтування та впровадження методів підтримувальної терапії пацієнтів з atopічним хейлітом із застосуванням різних груп зволожуючих засобів, які мають пом'якшувальну дію, стимулюють процеси епітелізації, усувають негативні наслідки захворювання. Метою дослідження було обґрунтування підтримувальної терапії у пацієнтів з atopічним хейлітом із застосуванням емоментів. У основу дослідження були покладені результати обстеження та лікування 19 пацієнтів з atopічним хейлітом, 12 (63 %) жінок та 7 (37 %) чоловіків, віком 20–36 років. Для проведення клінічного дослідження пацієнти були розподілені на дві групи: з легким ступенем перебігу хвороби 11 осіб (58 %), з перебігом середнього ступеня важкості atopічного хейліту 8 осіб (42 %). Підтримувальна терапія є необхідним етапом комплексного лікування хворих з atopічним хейлітом. Диференційоване застосування емоментів дозволяє на 10 день у 79 % пацієнтів отримати позитивні результати лікування. Запропонована схема підтримувальної терапії може бути рекомендована до використання у терапевтичній стоматології. Дотримання принципу партисипативності при розробці індивідуального курсу лікування atopічного хейліту сприяє підвищенню комплаєнтності пацієнта і, в кінцевому підсумку, його задоволеності лікуванням. Лише такий комплексний підхід допоможе зберегти відносно високу якість життя хворих і поліпшити прогноз щодо atopічного хейліту.

Ключові слова: atopія, червона кайма губ, емоменти.

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Supportive therapy is medicinal and non-medicinal types of treatment aimed at reducing the signs and manifestations of the disease in order to relieve well-being and improve the condition of patients; it is used to provide long-term control over the symptoms of the disease and prevent complications.

In patients with atopic dermatitis, atopic cheilitis occurs as a symptomatic (secondary) chronic inflammation of the red border of the lips, which is accompanied by a chronic relapsing course with a characteristic change of phases of remission and exacerbation [5, 8].

Modern ideas about the etiology and pathogenetic mechanisms of atopic development cheilitis are multifactorial, which is caused by a heavy polygenic heredity to atopy. Genetic factors determine the initial violations of the barrier function of the epidermis, which causes its high permeability to irritants and allergens that cause the formation of atopene antibodies [1, 7]. Risk factors for the development of atopic cheilitis is a