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Master's thesis

**MAGNETIC LASER THERAPY IN A COMPLEX  
TREATMENT OF PATIENTS WITH  
COMPLICATED FORMS CELLULITIS**

223 – Nursing

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## **RELEVANCE OF THE RESEARCH TOPIC.**

In the last decade, clinical and epidemiological the observations of many authors noted a change in the clinical course cellulitis towards a significant increase in the number of hemorrhagic forms, not decreasing the number of relapses, more frequent development of purulent-necrotic complications of the disease, a high mortality rate [2, 14, 15]. 10% to 16% of all patients who turned to the surgeon of the polyclinic account for patients with cellulitis and more than 6% of all these patients are admitted to specialized surgical departments. Moreover, among all patients with purulent septic pathology, admitted to specialized hospitals, more than 20% of patients with cellulitis [16, 18]. To solve this problem, a significant arsenal is proposed funds, in particular high-energy and low-energy lasers, plasma flows, photodynamic therapy [6, 10].

In a number of works in recent years, the effectiveness of the use of intravenous laser blood irradiation during treatment uncomplicated (erythematous, bullous, hemorrhagic) forms of cellulitis [1, 13]. In the literature there are isolated works about the possibility the use of magnetic laser therapy in the treatment of uncomplicated forms cellulitis [7] experimentally showed that the combination of a constant magnetic field (25-30 mT) and laser therapy (4.5-5.0 mW/cm<sup>2</sup>) is more effective than laser therapy and magneto therapy applied separately. The combination of these two methods is not the usual sum of the effect, but is of a synergistic-resonant nature, which has a more pronounced effect on the body [18]. At the same time, there are no reports in the literature on the use of magnetic laser therapy in the complex treatment of patients with complicated (phlegmonous, phlegmonous-necrotic) forms of cellulitis [11, 12]. This determined the relevance of this study. Thus, analyzing the current state of the problem, it should be recognized that at present there is no coherent program for the use of magnetic laser therapy in the treatment of patients with complicated forms of cellulitis, there are no reports on the characteristics of the course of the wound process during magnetic laser therapy of complicated forms of cellulitis and its effect on regional

microcirculation. The importance of the above problem for practical health care and the presence of many unexplored issues listed above served as the basis for the implementation of this study.

### **Purpose of the study.**

To improve the results of treatment of patients with complicated forms of cellulitis by using magnetic laser therapy.

### **Research objectives:**

1. To evaluate the effectiveness of complex treatment of patients with complicated forms of cellulitis using magnetic laser therapy.

2 Give a comparative characteristic of the course of the wound process in traditional treatment and magnetic laser therapy.

3. To assess the effect of magnetic laser therapy on regional microcirculation by laser Doppler flowmetry.

4. To develop and introduce into clinical practice a method of application magnetic laser therapy in the treatment of patients with complicated forms of cellulitis

### **Scientific novelty**

For the first time, a clinical and morphological study of the effect of magnetic laser therapy on reparative processes in patients with complicated forms of cellulitis was carried out and it was proved that the use of magnetic laser therapy in complex treatment leads to activation of the growth of granulation tissue and epithelialization of the wound defect.

For the first time, the characteristics of microcirculatory disorders in patients with complicated forms of cellulitis, which consist in changing functional parameters of the microcirculation system.

For the first time, a study of the effect of magnetic laser therapy on the state of the microvasculature in patients with complicated forms cellulitis and it has been proven that the use of magnetic laser therapy in complex treatment contributes to the

rapid restoration of sympathetic regulation vascular tone, normalization of venulo-arteriolar relationships, which leads to an adequate blood supply to tissues and relief of inflammation.

A new pathogenetically substantiated method of complex treatment of patients with complicated forms of cellulitis with the use of magnetic laser therapy has been developed, which makes it possible to significantly improve the results of treatment of this category of patients, reducing the treatment time by 1.35 times.

**The practical significance of the study.**

A new method of treating patients with complicated forms has been developed cellulitis with the use of a magnetic laser in the postoperative period therapy. The application of the developed technique helps to reduce terms of cleansing the wound surface from purulent-necrotic masses, stimulation of proliferation and epithelization processes, which allows 3 times reduce the number of re-treatments and improve results treatment of complicated forms of cellulitis, reducing the time of their healing by 1.5-2 times.

The work is set out on 43 pages of typewritten text and consists of an introduction and 3 chapters: review of literature, materials and methods research, results of examination and treatment, conclusions, conclusions, practical recommendations and an index of literature, including 42 sources. The work is illustrated with 5 tables and 4 figures.

## **CHAPTER 1**

### **LITERATURE REVIEW**

Cellulitis is an acute infectious and allergic disease characterized by local skin inflammation, intoxication and fever, affecting the superficial lymphatic system [17, 19].

Information on the incidence of cellulitis is very contradictory, since this nosology is not subject to statistical registration. According to the literature, it is in the range of 12-20%. There is no information about what factual material was used to determine it. The fact is that we could talk about accounting for cases of primary and recurrent cellulitis. It is possible that all cases of cellulitis, including recurrent ones, were taken into account, in other words, it was about pain. And, finally, the option was not ruled out that when determining the incidence, all visits of patients with this disease to a polyclinic or hospital were taken into account [20, 22].

#### **1.1. Etiology of the disease**

The causative agent of cellulitis is streptococcus, belonging to various types. It has now been established that the staphylococcal flora in the area of the inflammation focus is activated and, in synergy with streptococcus, takes an active part in the development of the pathological process. The onset of cellulitis and its relapses are preceded by abrasions, bruises, thrombophlebitis of the extremities, trophic ulcers, varicose veins of the legs, calluses, diaper rash, intense sun exposure, hypothermia, fungal and other skin diseases, acute respiratory infections, diseases of the liver and cardiovascular system. The spread of cellulitis is associated with poor living conditions, the influence of humidity, and violation of hygiene rules [17, 21].

The main etiological agent leading to cellulitis inflammation of the skin or mucous membranes is hemolytic streptococcus. To establish the etiology of cellulitis, after cleaning the inflamed area on the demarcation line, the inflamed tissue is scarified

with a sterile scalpel, a drop of inflammatory exudate is taken with a loop and inoculated on a nutrient medium - sugar broth. In rare cases, with a severe course of the cellulitis process and the developed clinical picture of septicemia, by performing a blood culture, it is possible to obtain a culture of the microbes that caused the underlying disease [24].

## **1.2. Epidemiology**

Cellulitis is a widespread sporadic disease with low contagiousness. Low contagiousness of cellulitis is associated with improved sanitary and hygienic conditions and compliance with antiseptic rules in medical institutions. Despite the fact that patients with cellulitis are often hospitalized in general departments (therapy, surgery), among their ward neighbors, repeated cases of cellulitis are rarely recorded in the families of patients. In about 10% of cases, a hereditary predisposition to the disease was noted. A wounded face is now extremely rare. Cellulitis in newborns is practically absent. which is characterized by high mortality [23].

Cellulitis ranks 4th among infectious diseases, second only to respiratory and intestinal diseases, as well as hepatitis. The incidence is 12-20 cases per 10,000 population. The number of patients increases in summer and autumn [25, 33].

The number of relapses has increased by 25% over the past 20 years. 10% of people have a second episode of cellulitis within 6 months, 30% within 3 years. Repeated cellulitis in 10% of cases ends with lymphostasis and elephantiasis [19, 26].

Doctors have noted an alarming trend. If in the 70s the number of severe forms of cellulitis did not exceed 30%, today there are more than 80% of such cases. At the same time, the number of mild forms has decreased, and the period of fever now lasts longer.

30% of cases of cellulitis are associated with impaired blood and lymph flow in the lower extremities, with varicose veins, thrombophlebitis, lymphovenous insufficiency.

Mortality from complications caused by cellulitis (sepsis, gangrene, pneumonia) reaches 5%. Currently, the etiological role of group A  $\beta$ -hemolytic streptococcus (GABHS) - *S. pyogenes* in the development of cellulitis is an indisputable fact, streptococci of groups C and G are of lesser importance. The source of infection is both patients with various streptococcal infections, and healthy bacteria carriers of streptococcus (dangerous for others at 10<sup>3</sup> CFU) [17, 20].

The main transmission mechanism is contact (*S.pyogenes* penetrates through small skin lesions - microtrauma, abrasions, skin rash, etc.). The airborne transmission of streptococcus with a primary lesion of the nasopharynx and the subsequent drift of the microbe onto the skin by hands, as well as by the lymphogenous and hematogenous route, is also of some importance [26].

When infected with streptococcus, the disease develops only in persons who have a congenital or acquired predisposition to it. Patients with cellulitis are less contagious. Unlike other streptococcal infections, cellulitis has a summer-fall seasonality.

Women suffer from cellulitis 2 times more often than men, especially with a recurrent form of the disease. In more than 60% of cases, people aged 40 and older carry cellulitis. Primary and recurrent forms of cellulitis are recorded in women mainly in the late reproductive (36-45 years) and postmenopausal (over 50 years) periods, and in men more often over the age of 50.

Among the patients, persons engaged in manual labor predominate. More often, cellulitis is registered in drivers, cleaners, cooks and people of other professions associated with frequent microtraumatization and skin contamination. A high incidence of cellulitis was also noted among pensioners and housewives. The majority of patients with primary and recurrent forms of cellulitis have background (concomitant) diseases. The development of cellulitis on the chest, upper limbs in women is almost always preceded by mastectomy, post-mastectomy lymphedema. More often, concomitant

diseases are observed in patients with recurrent cellulitis. More than half of patients with primary and recurrent cellulitis have 2 or more background diseases [18, 23].

In 6 - 10% of cases, cellulitis occurs against the background of diabetes mellitus, which should be paid special attention to when examining and treating patients. Provoking factors in the form of hypothermia, micro trauma, stress (psychotrauma), acute respiratory infections are recorded in most patients. In 35.7% of patients with recurrent cellulitis, provoking factors cannot be identified, which indicates the likelihood of endogenous foci of infection [20, 24].

#### Features of the disease cellulitis

- The disease affects people of all age groups. But the majority of patients (over 60%) are women over 50 years old.
- There is cellulitis in infants when streptococcus enters the umbilical wound.
- There is evidence that people with the third blood group are most susceptible to cellulitis.
- Cellulitis is a disease of civilized countries. On the African continent and in South Asia, people rarely get sick.

Cellulitis occurs only in people with weakened immunity, weakened by stress or chronic illness. Studies have shown that the development of the disease is associated with an inadequate response of the immune system to the ingress of streptococcus into the body. The balance of immune cells is disturbed: the number of T-lymphocytes and immunoglobulins A, M, G decreases, but an excess of immunoglobulin E is produced. Against this background, the patient develops an allergy.

Observations of patients with cellulitis at the present time do not confirm the provisions on the easy mechanism of its transmission. This is indicated by the fact that 9-10% of patients are sent to special hospitals for patients with cellulitis with an erroneous diagnosis (trophic ulcers, lymphangitis, thrombophlebitis, phlegmon) and these patients did not get sick with cellulitis.

The penetration of infection occurs mainly exogenous, less often endogenous - through the lymphatic and blood vessels. With the beginning of the use of antibiotics and sulfonamides in medical practice, against the background of asepsis, the use of antiseptics and the improvement of hygienic conditions, the spread of cellulitis has decreased.

With primary cellulitis, group A beta-hemolytic streptococcus penetrates the skin or mucous membranes through cracks, diaper rash, various microtraumas (exogenous pathway). With face cellulitis - through cracks in the nostrils or damage to the external auditory canal, with cellulitis of the lower extremities - through cracks in the interdigital spaces, on the heels or damage in the lower third of the leg. Damage includes minor cracks, scratches, pinpoint punctures and microtrauma[17, 24].

Currently, only isolated cases of cellulitis are recorded in patients under the age of 18. From the age of 20, the incidence increases, and in the age range from 20 to 30 years, men get sick more often than women, which is associated with the predominance of primary cellulitis and the occupational factor. The majority of patients are persons aged 50 and over (up to 60-70% of all cases). Manual workers predominate among the employed. The highest incidence rate is noted among locksmiths, porters, chauffeurs, bricklayers, carpenters, cleaners, kitchen workers and people of other professions associated with frequent micro traumatization and skin contamination, as well as sudden changes in temperature. Housewives and retirees are relatively often sick, and they usually have recurrent forms of the disease. The rise in incidence is noted in the summer-autumn period.

Post-infectious immunity is fragile. Almost a third of patients develop a recurrent disease or a recurrent form of the disease caused by autoinfection, reinfection or superinfection with strains of p-hemolytic streptococcus group A, which contain other variants of the M-protein.

### **1.3. Pathogenesis**

The pathological anatomy of cellulitis is well understood. At the beginning of the disease, a delimited hyperemic area of the skin appears in the form of a plaque, prone to further spread. There is edema of the affected area of the skin, limited by a kind of roller. The most characteristic microscopic feature of cellulitis is the defeat of the small lymphatic vessels and the microcirculation system - arterioles, metarterioles, capillaries, venules. Cellulitis is characterized not only by lymphangitis, but also by phlebitis, arteritis. Serous inflammation arising at the beginning is localized in the reticular layer of the skin, partly in the subcutaneous fatty tissue along the lymphatic vessels. Serous exudate with a high content of neutrophils and lymphocytes permeates tissues, fills the intercellular spaces and lymphatic vessels, in which, moreover, desquamation of the endothelial layer is observed. The vessels of the microcirculation system expand, their permeability increases, as a result, the edema of the surrounding tissues increases even more and in some cases erythrocytes go out into the intercellular spaces, which explains the presence of sometimes found blisters with hemorrhagic contents. With significant edema and increased permeability of capillary vessels, the exudate exfoliates the epidermis. This is how pustules appear in the bullous form of cellulitis. With the involvement of subcutaneous fatty tissue in the process and its impregnation with inflammatory exudate, phlegmonous cellulitis develops. If intravascular thrombosis joins the paresis of capillary vessels and larger highways, then a necrotic form of cellulitis occurs [23, 25].

The pathogenesis of cellulitis is complex. Cellulitis develops under the influence of both exogenous and endogenous streptococcal infection with a weakening of the general resistance of the body and local - tissues. The very presence of streptococcus in the body, regardless of the routes of introduction, does not yet lead to the development of the disease; the most important is the change in the reactivity of the organism, its allergic and autoallergic reactions.

The inflammatory reaction is accompanied by such changes in homeostasis as immunological and hormonal changes, violations of vascular permeability, water-salt, protein and other types of metabolism. Relapses of cellulitis are explained by an infection "smoldering" in the focus of the sensitized organism. As a result of allergic restructuring, various stimuli, according to the laws of par allergy, acquire the properties of a resolving factor, becoming the cause of relapses. The defeat of the skin and lymphatic apparatus is rarely accompanied by the generalization of infection and the formation of septic foci in the internal organs. Streptococci with cellulitis are "extreme irritants exceeding the measure" (according to IP Pavlov), "stressors" (according to Selye), leading to specific reactions (the formation of antibodies) and nonspecific in the form of toxemia syndrome, allergization of the body, etc. With cellulitis, regardless of the mechanism of infection (infection from the outside or autoinfection), the pathogenesis is based on the infectious process of streptococcal etiology in persons with severe allergies and toxemia syndrome [26].

#### **1.4. Classification**

The classification of cellulitis is based on local and general manifestations of the disease. There are forms of cellulitis:

- erythematous,
- bullous,
- phlegmonous
- necrotic (gangrenous).

The main manifestations of the first form are bright hyperemia of the affected areas, edema and hyperesthesia. In the second form, pustules with serous or serous-purulent contents join these phenomena. If subcutaneous fatty tissue is involved in the process, a phlegmonous form develops. Necrosis is a consequence of organic

circulatory disorders in the area of the inflammatory reaction, which is often observed in cellulitis of the eyelids and scrotum.

There are primary and secondary cellulitis: the primary one occurs when there are no foci of purulent inflammation in the body, and the secondary is a complication of a festering wound or other focus of purulent inflammation.

By the time of development, the cellulitis is divided into:

- primary;
- repeated;
- recurrent.

With repeated cellulitis in a sensitized organism, more than a year later, a process of the same or up to a year - a different localization may occur. With recurrent cellulitis, the infection develops in the previous focus of the sensitized organism within a year, or cellulitis is repeated more than 5 times in different areas. Distinguish between early relapses (up to 6 months) and late (from 7 to 12 months).

According to the localization of the process, cellulitis are distinguished:

- heads;
- faces;
- limbs;
- torso, etc.

According to the severity of the disease, it is customary to divide into mild, moderate and severe forms, which are established depending on the syndrome of toxemia (body temperature, reaction to the environment, intensity of headache, sleep disturbance, the presence of nausea, vomiting, degree of weakness, damage to the cardiovascular system ) and the severity of the local process [4].

Nowadays, more and more often, especially in the conditions of polyclinics and outpatient clinics, in addition to the typical, atypical, abortive, erased forms of cellulitis are observed. The erased course of the disease is mild, and the atypical one can be

severe. Abortive, erased, sometimes with almost no general reaction, relapses of cellulitis can also occur.

Localized, creeping and migratory cellulitis are also distinguished. With a localized form, the pathological process remains in one area throughout the disease. Sometimes cellulitis, appearing on a specific area of the body, spreads to neighboring areas. This form of inflammation is called creeping cellulitis. With a migratory form, the process goes to distant areas of the skin.

### **1.5 Symptoms**

The incubation period is from several hours to 3 - 5 days. In patients with a recurrent course of cellulitis, the development of the next attack of the disease is often preceded by hypothermia and stress. In the vast majority of cases, the disease begins acutely.

Common symptoms of cellulitis. The initial period of the disease is characterized by the rapid development of symptoms of intoxication, which in more than half of patients (usually with localization of cellulitis on the lower extremities) for a period of several hours to 1 - 2 days ahead of the onset of local manifestations of the disease. Headache, general weakness, chills, muscle pain are noted. In 25 - 30% of patients, nausea and vomiting appear. Already in the first hours of the disease, the temperature rises to 38 - 40 ° C. On areas of the skin in the area of future local manifestations, a number of patients develop paresthesias, a feeling of bloating or burning, and non-intense pain. Often there are also pains in the area of enlarged regional lymph nodes [17, 21] .

The height of the disease occurs within a period from several hours to 1 - 2 days after the first manifestations of the disease. General toxic manifestations and fever reach their maximum. There are characteristic local manifestations of cellulitis. Most often, the inflammatory process is localized on the lower extremities (60 - 70%), less often on

the face (20 - 30%) and upper extremities (4 - 7%), very rarely only on the trunk, in the region of the mammary gland, perineum, external genital organs.

With timely initiation of treatment and uncomplicated course of cellulitis, the duration of fever usually does not exceed 5 days. In 10 - 15% of patients, fever persists for more than 7 days, which is usually observed with a widespread process and insufficiently complete etiotropic therapy. The most prolonged febrile period is noted with bullous-hemorrhagic cellulitis. More than 70% of patients with cellulitis develop regional lymphadenitis, which develops in all forms of the disease.

Convalescence period. Normalization of temperature and the disappearance of symptoms of intoxication are observed with cellulitis earlier than the disappearance of local manifestations. Acute local manifestations of the disease persist up to 5 - 8 days, with hemorrhagic forms - up to 12 - 18 days or more. The residual effects of cellulitis, which persist for several weeks and months, include pasty and pigmentation of the skin, congestive hyperemia at the site of extinct erythema, dense dry crusts at the site of bullae, edema syndrome [24].

Persistent enlarged and painful lymph nodes, skin infiltrates in the area of an extinct focus of inflammation, low-grade fever have an unfavorable prognostic value (the likelihood of an early relapse). Long-term preservation of lymphatic edema (lymphostasis), which should be considered as an early stage of secondary elephantiasis, is also unfavorable prognostically. Hyperpigmentation of skin areas on the lower extremities in patients who have undergone bullous-hemorrhagic cellulitis can persist for life.

### **1.6. Clinical forms**

Erythematous cellulitis can be both an independent clinical form of cellulitis and the initial stage of development of other forms of cellulitis. A small red or pink spot appears on the skin, which within a few hours turns into a characteristic cellulitis

erythema. Erythema is a clearly demarcated area of hyperemic skin with uneven boundaries in the form of teeth, tongues.

The skin in the area of erythema is infiltrated, tense, hot to the touch, moderately painful on palpation (more on the periphery of the erythema). In some cases, you can find a "peripheral roller" in the form of infiltrated and raised edges of erythema. Along with hyperemia and infiltration of the skin, its edema develops, extending beyond the erythema [56d].

Erythematous-bullous cellulitis develops in a period from several hours to 2 - 5 days against the background of cellulitis erythema. The development of blisters is associated with increased exudation in the focus of inflammation and the detachment of the epidermis from the dermis by accumulated fluid. In case of damage to the surfaces of the bubbles or their spontaneous rupture, exudate flows out, often in large quantities erosion occurs in the place of the bubbles. While maintaining the integrity of the bubbles, they gradually shrink with the formation of yellow or brown crusts.

Erythematous-hemorrhagic cellulitis develops against the background of erythematous cellulitis within 1 to 3 days from the onset of the disease, sometimes later. Hemorrhages of various sizes appear - from small petechiae to extensive confluent hemorrhages, sometimes throughout the entire erythema.

Bullous-hemorrhagic cellulitis is transformed from an erythematous-bullous or erythematous-hemorrhagic form and occurs as a result of deep damage to the capillaries and blood vessels of the reticular and papillary layers of the dermis. Bullous elements are filled with hemorrhagic and fibrinous-hemorrhagic exudate, there are extensive hemorrhages in the skin in the area of erythema. The resulting bubbles are of different sizes, have a dark color with translucent yellow fibrin inclusions.

Vesicles may contain predominantly fibrinous exudate. The appearance of extensive flattened blisters, dense on palpation due to significant deposition of fibrin in them, is possible. In patients with active repair, brown crusts quickly form at the site of

the blisters in the lesion. In other cases, the bladder covers rupture and are torn away together with clots of fibrinous-hemorrhagic contents, exposing the eroded surface.

In most patients, its gradual epithelization occurs. With significant hemorrhages in the bottom of the bladder and the thickness of the skin, necrosis may develop, sometimes with the addition of secondary suppuration, the formation of ulcers.

The criteria for the severity of cellulitis are the severity of intoxication and the prevalence of the local process [9].

The mild (I) form of cellulitis includes cases with minor intoxication, low-grade fever, localized (more often erythematous) local process.

The moderate (II) form of the disease is characterized by severe intoxication. General weakness, headache, chills, muscle pain, sometimes nausea, vomiting, fever up to 38 - 40 ° C, tachycardia, hypotension are noted in almost half of the patients. The local process can be both localized and widespread (it covers two anatomical regions) in nature.

The severe (III) form of cellulitis includes cases of the disease with severe intoxication: intense headache, repeated vomiting, hyperthermia (above 40 ° C), sometimes an eclipse of consciousness, phenomena of meningism, convulsions.

Significant tachycardia, often hypotension, are noted, in elderly and senile people, with late treatment started, the development of acute cardiovascular failure is possible. A widespread bullous-hemorrhagic cellulitis with extensive blisters should be considered severe and in the absence of pronounced toxicosis and hyperthermia.

With different localization of cellulitis, the clinical course of the disease and its prognosis have their own characteristics. Cellulitis of the lower extremities is the most common localization of the disease (60 - 70%). Hemorrhagic forms of the disease are characteristic with the development of extensive hemorrhages, large blisters, followed by the formation of erosions and other skin defects. For this localization of the process, the most typical lesions of the lymphatic system in the form of lymphangitis,

periadenitis, chronically recurrent course of the disease. The latter is largely facilitated by background concomitant conditions - chronic venous insufficiency, primary disorders of lymph circulation, mycoses, etc.

Cellulitis of the face (20 - 30%) is usually observed in primary and recurrent forms of the disease. With it, the often recurrent course of the disease is relatively rare. With timely treatment started, cellulitis of the face proceeds more easily than cellulitis of other localizations. Quite often it is preceded by tonsillitis, acute respiratory diseases, exacerbations of chronic sinusitis, otitis media, caries.

Cellulitis of the upper extremities (5-7%), as a rule, occurs against the background of postoperative lymphostasis (elephantiasis) in women operated on for a breast tumor. Cellulitis of this localization in women tends to recur. One of the main aspects of the problem of cellulitis as a streptococcal infection is the tendency of the disease to a chronically recurrent course (in 25 - 35% of all cases).

Relapses in cellulitis can be late (occur a year or more after the previous outbreak of cellulitis with the same localization of the local inflammatory process), seasonal (occur annually for many years, most often in the summer-autumn period). Late and seasonal relapses of the disease, which are usually the result of reinfection, do not differ in clinical course from typical primary cellulitis, although they occur against the background of persistent lymphostasis and other consequences of previous outbreaks of the disease.

Early and frequent relapses (3 relapses per year or more) are exacerbations of a chronic disease. In more than 70% of patients, recurrent cellulitis often occurs against the background of various concomitant conditions, accompanied by disorders of skin trophism, a decrease in its barrier functions, and local immunodeficiency. These include: primary lymphostasis and elephantiasis of various etiologies, chronic venous insufficiency (post-thrombophlebitic syndrome, varicose veins), fungal skin lesions, diaper rash, etc. Chronic ENT infection, diabetes mellitus, obesity are of certain

importance for the formation of recurrent cellulitis. The combination of two or three of the listed underlying diseases significantly increases the possibility of frequent relapses of the disease, and persons suffering from them constitute a risk group.

Complications of cellulitis, mainly local in nature, are observed in 5-8% of patients. Local complications of cellulitis include abscesses, phlegmon, skin necrosis, pustulization of bullae, phlebitis, thrombophlebitis, lymphangitis, periadenitis. The most common complications occur in patients with bullous hemorrhagic cellulitis. With thrombophlebitis, the subcutaneous veins are more often affected and, less often, the deep veins of the lower leg. Treatment of these complications should be carried out in purulent surgical departments. Common complications that develop in patients with cellulitis are quite rare, include sepsis, toxic-infectious shock, acute cardiovascular failure, pulmonary embolism, etc.

The consequences of cellulitis include persistent lymphostasis (lymphedema) and secondary elephantiasis itself (fibredema), which are two stages of the same process. According to modern concepts, persistent lymphostasis and elephantiasis in most cases develop in patients with cellulitis against the background of already existing functional insufficiency of the skin lymph circulation (congenital, post-traumatic, etc.).

The recurrent cellulitis that arises against this background significantly increases the existing (sometimes subclinical) disorders of the lymph circulation, leading to the formation of the consequences of the disease. Successful anti-relapse treatment of cellulitis (including repeated courses of physical therapy) can lead to a significant reduction in lymphatic edema. With already formed secondary elephantiasis, only surgical treatment is effective.

### **1.7. Diagnostic methods**

The diagnostic criteria for cellulitis in typical cases are [27, 29]:

- acute onset of the disease with severe symptoms of intoxication, an increase in body temperature to 38-39 ° C and above;
- preferential localization of the local inflammatory process on the lower extremities and face;
- development of typical local manifestations with characteristic erythema, possible local hemorrhagic syndrome;
- development of regional lymphadenitis;
- absence of severe pain in the focus of inflammation at rest.

### **1.8. Treatment principles**

In most cases, therapeutic measures for cellulitis are carried out at home or on an outpatient basis. Patients are shown to drink plenty of fluids, a balanced diet. The indications for hospitalization are a severe course of the disease, a widespread local process, its bullous-hemorrhagic nature and recurrent cellulitis.

Treatment of patients with cellulitis should be carried out taking into account the form of the disease, primarily its frequency (primary, repeated, recurrent, often recurrent cellulitis), as well as the degree of intoxication, the nature of local lesions, the presence of complications and consequences. Currently, most patients with a mild course of cellulitis and many patients with a moderate form of the disease are treated in a polyclinic [16, 13w].

Indications for compulsory hospitalization in infectious diseases hospitals (departments) are:

- severe course of cellulitis with pronounced intoxication or widespread skin lesions (especially in the bullous-hemorrhagic form of cellulitis);
- frequent relapses of cellulitis, regardless of the degree of intoxication, the nature of the local process;

- the presence of severe general concomitant diseases;
- senile or childish age.

Cellulitis treatment methods currently used can be divided into several groups:

- 1) local funds;
- 2) antibacterial drugs;
- 3) desensitizing therapy;
- 4) stimulating therapy.

General treatment.

The main and components are:

- Antibacterial therapy: use semi-synthetic penicillins (ampicillin 2.0-4.0 mg per day) in combination with sulfonamides (streptocid, sulfadimethoxin, sulfalene).

For severe hemorrhagic forms and relapses of the disease, second-generation cephalosporins are used. The method of choice is lymphotropic administration of antibiotics (CRT is difficult to perform due to pronounced edema of the distal extremities). Usually 3-4 lymphotropic injections quickly relieve the main manifestations of the disease.

- Detoxification therapy is usually needed within the first 4-5 days. Intravenous infusions of crystalloid solutions (1.5-2.0 liters per day) are used, and in severe cases, detoxifying blood substitutes and blood products. An effective method of treatment is UV or laser blood irradiation [.

- Desensitizing therapy consists in the administration of antihistamines (diphenhydramine, tavegil, diazolin).

- Strengthening the vascular wall is necessary for hemorrhagic forms. Apply ascorbic acid, askorutin.

Treatment of patients with recurrent cellulitis. Treatment of this form of the disease should be carried out in a hospital setting. It is imperative to prescribe backup antibiotics that have not been used in the treatment of previous relapses. Prescribed

cephalosporins (I or II generation) intramuscularly at 0.5 - 1.0 g 3-4 times a day or lincomycin intramuscularly 0.6 g 3 times a day, rifampicin intramuscularly 0.25 g 3 times a day. The course of antibacterial therapy is 8-10 days. In case of particularly persistent relapses of cellulitis, a two-course treatment is advisable [30, 36].

Antibiotics are consistently prescribed that have an optimal effect on bacterial and L-forms of streptococcus. The first course of antibiotic therapy is carried out with cephalosporins (7-8 days). After a 5-7-day break, a second course of treatment with lincomycin is carried out (6-7 days). With recurrent cellulitis, immunocorrective therapy is indicated (methyluracil, sodium nucleinate, prodigiosan, T-activin) [32, 34, 37].

The widespread use of antibiotics and sulfonamides in this disease has made it possible to somewhat reduce the number of deaths. However, cellulitis inflammation occupies a relatively large share in the structure of infectious diseases. Many authors point to the disadvantages of antibiotic therapy, since it remains a rather high frequency of repeated diseases and relapses of cellulitis. The increasing number of antibiotic-resistant strains, especially in patients with recurrent cellulitis, does not provide complete sanitation of the body from the pathogen. All this leads to the need to find new, more effective methods of treatment that would affect the lesion and stimulate the activity of the body [28, 41].

Local therapy. Treatment of local manifestations of the disease is carried out only with its bullous forms with the localization of the process on the extremities.

The erythematous form of cellulitis does not require the use of local remedies, and many of them (ichthyol ointment, Vishnevsky's balm, antibiotic ointments) are generally contraindicated. In the acute period of cellulitis, in the presence of intact blisters, they are carefully incised at one of the edges and, after the exudate emerges, bandages are applied to the inflammation focus with 0.1% rivanol solution or 0.02% furacilin solution, changing them several times during the day. Tight bandaging is

unacceptable. In the presence of extensive weeping erosions at the site of the opened blisters, local treatment begins with manganese baths for the extremities, followed by the imposition of the dressings listed above. For the treatment of local hemorrhagic syndrome in erythematous-hemorrhagic cellulitis, 5-10% dibunol liniment is prescribed in the form of applications in the area of the inflammation 2 times a day for 5-7 days. Timely treatment of hemorrhagic syndrome significantly reduces the duration of the acute period of the disease, prevents the transformation of erythematous-hemorrhagic cellulitis into bullous-hemorrhagic, accelerates reparative processes, prevents complications characteristic of hemorrhagic cellulitis [27, 39].

### **1.9. Prevention**

In the prevention of cellulitis, it is essential:

- Dispensary observation.
- Treatment of concomitant diseases.
- Remediation of foci of infection.
- Rational employment.
- Compliance with the rules of personal hygiene.
- Prevention of injury.

There is no specific prophylaxis for cellulitis. Prevention of primary cellulitis is based on the timely treatment of injuries, purulent diseases of the skin and subcutaneous tissue, skin diseases, etc. In the prevention of recurrent and repeated forms, prevention of hypothermia, dampness, hyperinsolation is important. It is important to exclude harmful industrial and household factors, to prevent and eliminate microtrauma, maceration, diaper rash, skin abrasions, to observe the rules of personal hygiene, to take measures to temper the body (including physical factors) [38, 42].

## **CHAPTER 2**

### **GENERAL CHARACTERISTICS OF OBSERVATIONS AND RESEARCH METHODS**

Analysis of the results of examination and treatment of 105 patients complicated forms of cellulitis treated at the Manor Care clinic city of Chicago in the period from 2019-2020. Among the patients there were 77 (73.3%) women and 28 (26.7%) men; according to our study, women suffered from complicated forms of cellulitis 2.75 times more often than men. The age of the patients was from 32 to 75 years, however, the majority of 81 (77.1%) patients were under 60 years old, 24 (22.9%) over 60 years old. The mean age was  $47.8 \pm 2.6$  years. When patients applied to the clinic, the following studies were performed: general clinical research methods (clinical blood analysis, clinical analysis of urine, biochemical blood analysis, study of the blood coagulation system), instrumental studies (ultrasound Doppler, laser Doppler flowmetry).

The treatment regimen for patients with complicated forms of cellulitis included surgical treatment, antibiotic therapy (antibiotics of a wide spectrum of action), desensitizing drugs, detoxification therapy (in severe cases). Local treatment included in the wound wound phase the process of dressing with antiseptic solutions (solution of iodopyrone 1%, solution chlohexidine 0.1%), biological necrolysis and fibrinolysis were carried out using proteolytic enzymes (trypsin). In the second phase of the wound process, preparations based on hyaluronic acid were used. Surgical interventions were performed urgently, under general anesthesia.

Depending on the applied treatment methods, the patients were divided into 2 groups (Table 1).

Group 1 (control) was represented by 55 patients who surgical treatment of a purulent focus and traditional drug therapy.

Group 2 (main) included 50 patients who, in addition to surgical treatment of a purulent focus and traditional treatment carried out magnetic laser therapy.

Table 1

Distribution of patients depending on the method of treatment.

	Treatment methods	Number of patients	
		Absolute number	%
	Traditional treatment	55	52.4
	Traditional treatment + Magneto-lazar therapy	50	47.6
	Total	105	100

For magnetic laser therapy used a laser therapeutic device "Azor-2k" with magnetic attachments. The exposure parameters are wavelength 0.89  $\mu\text{m}$ , power 10 W, pulse repetition rate 80 Hz, constant magnetic field 25 mT, exposure per zone 2 min (Pic 1).



ulitis

Magnetic laser technique therapy in patients with complicated forms of cellulitis of the lower extremities included the impact on the following points - the projection of large vessels (femoral, popliteal), regional lymph nodes, posterior muscle group shins, wound.

To systematize patients depending on the level of lesion. We used the classification of soft tissue lesions in surgical infections [??]. Depending on the level of soft tissue lesions, patients were distributed as follows: II degree - 92 (87.6%) patients, III degree-11 (10.5 %), IV degree-2 (1.9%) patient (Tabl. 2, Fig. 1).

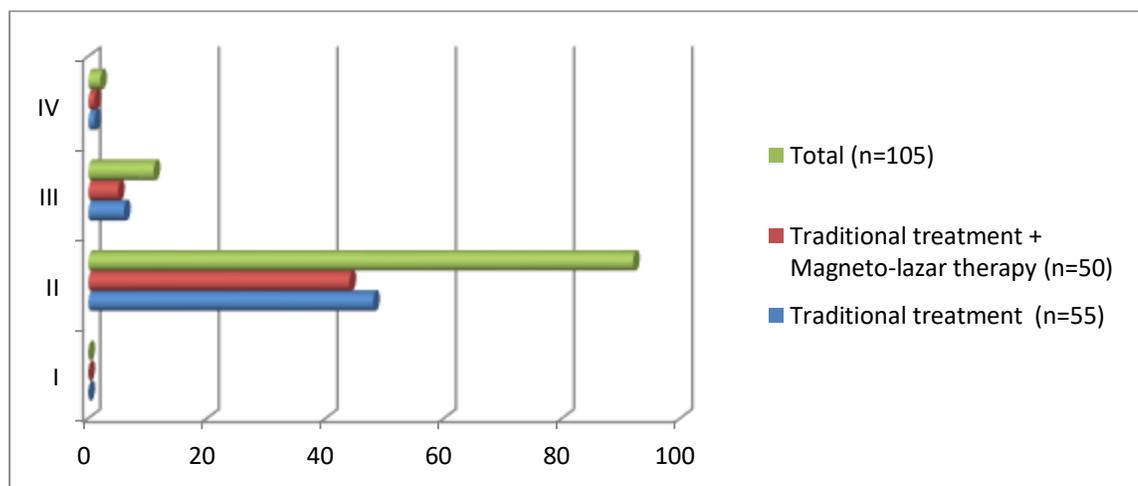
Table 2

Distribution of patients with cellulitis depending on the level of soft tissue damage (according to the classification of Ahrenholz D.H. (1991) (n,%)

Degree	Group		Total % (n=105)
	Traditional treatment (n=55)	Traditional treatment + Magneto-lazar therapy (n=50)	
I	-	-	-
II	48	44	92 (87.6)
III	6	5	11 (10.5)
IV	1	1	2 (1.9)

Figure 1.

Distribution of patients with cellulitis depending on the level of soft tissue damage



Most often, in patients with complicated cellulitis, the process was localized on the lower limbs - 93 (88.6%) on one lower limb in 90 (96.8%) patients, on both lower limbs in 3 (3.2%). Localization of the process on the upper limb was noted in 12 (11.4%) patients. The foci of phlegmonous and phlegmonous-necrotic changes in 78 (74.3%) cases were localized on the legs, in 12 (11.4%) patients, the lesion from the lower leg extended to the dorsum of the foot, in 11 (10.5%) patients purulent-necrotic the process involved the lower leg and thigh, and in 4 (3.8%) cases, the lesion of the thigh, lower leg and foot was revealed. Primary cellulitis was detected in 45 (42.9%) patients, a recurrent form of cellulitis was noted in 39 (37.1%) patients, a recurrent form in 21 (20%) patients.

In patients with complicated forms of cellulitis, the following concomitant diseases were identified. Chronic venous insufficiency was observed in 52 (49.5%) patients, coronary heart disease was detected in 35 (33.3%) patients, hypertension - in 27 (25.7%). %) of patients Chronic obstructive pulmonary disease occurred in 17 (16.2%) patients, diabetes mellitus - in 31 (29.5%) patients, chronic pyelonephritis - in 6 (5.7%) patients, obesity of 2-3 degrees - in 25 (23.8%) people In 45 patients (42.9%), a combination of several concomitant diseases was noted, which led to a significant aggravation of the underlying pathology and deterioration of treatment results.

The treatment of concomitant diseases was carried out in conjunction with specialized specialists. The duration of the disease, the extent of the lesion, the presence of intoxication, concomitant diseases determined the severity of the condition upon admission. Thus, 63 (60%) patients were in a satisfactory condition, 29 (27.6%) were of moderate severity, a severe condition was noted in 13 (12.4%) patients. Patients in the comparison groups were representative in terms of age, sex, duration, severity and extent of the lesion, and the presence of concomitant diseases. For scientific argumentation and confirmation of the effectiveness of the method's impact on the

course of the wound process, along with clinical methods, morphological and pathophysiological (laser Doppler flowmetry) research methods were used.

### CHAPTER 3 RESEARCH RESULTS AND THEIR DISCUSSION

Evaluation of the clinical results of treatment showed that in the first group of 55 operated patients, repeated surgical treatment (necrectomy) was required for 19 (34.5%) patients. In the second group, where complex treatment with magnetic laser therapy was carried out, in 6 (12%) of 50 patients also underwent re-debridement. As a rule, repeated surgical treatment was performed 2-4 days after the initial one. The use of magnetic laser therapy made it possible to increase the effectiveness of postoperative treatment of wounds and to reduce the number of repeated surgical treatments (necrectomies) by 3.2 times. A comparative assessment of the dynamics of the course of the wound process with various methods of treatment revealed that with traditional treatment, the cleansing of wounds from purulent detritus and fibrinous masses occurred after  $12.9 \pm 0.7$  days, the appearance of granulations - after  $10.1 \pm 0.9$  days, marginal epithelialization after  $18.7 \pm 1.6$  days (Tabl. 3, Fig. 2).

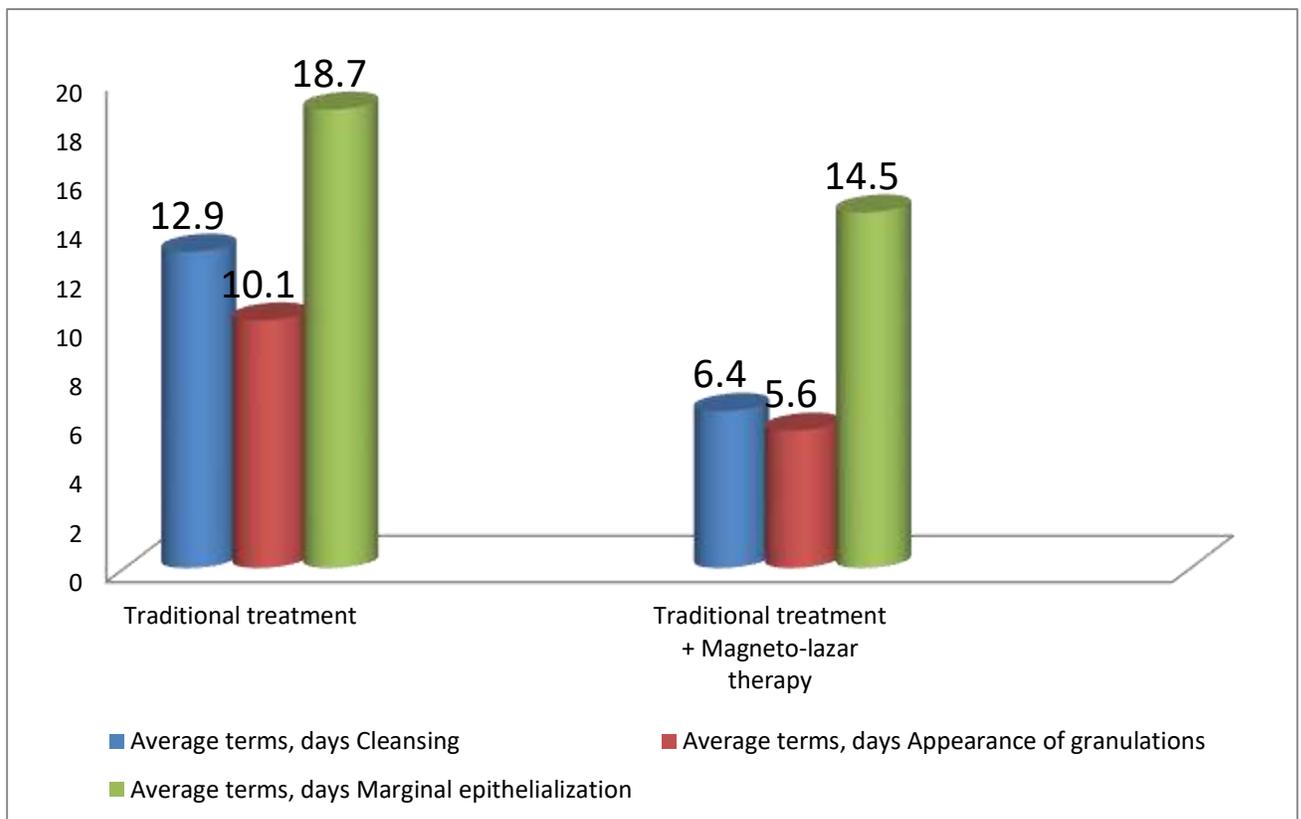
Table 3

#### Dynamics of the wound process in groups

Treatment method	Qty sick	Average terms, days		
		Cleansing	Appearance of granulations	Marginal epithelialization
Traditional treatment	55	$12,9 \pm 0,7$	$10,1 \pm 0,9$	$18,7 \pm 1,6$
Traditional treatment + Magneto-lazar therapy	50	$6,4 \pm 0,8^*$	$5,6 \pm 0,9^*$	$14,5 \pm 0,7^*$

Note \* - the reliability of the difference from the indicators of the group with traditional treatment ( $p < 0.001$ ).

Dynamics of the wound process in groups



In the group where complex treatment with the use of magnetic laser therapy was carried out, these indicators were significantly better, respectively - wound cleansing - after  $6.4 \pm 0.8$  days, the appearance of granulations - after  $5.6 \pm 0.9$  days, marginal epithelization - after  $14.5 \pm 0.7$  days.

After cleansing and granulating wounds, perifocal inflammatory manifestations in all cases were stopped, but significant size of wounds required plastic closure of wound surfaces with sutures or autodermoplasty. In the group of patients where traditional treatment, plastic surgery was performed on the 18 - 21 days after the start of treatment, on average after  $19.3 \pm 1.5$  days. When using a magnetic laser therapy, the period of preparation of wounds for plastic closure was  $15.2 \pm 0.8$  days on average, these periods are significantly shorter than with traditional treatment ( $p < 0.001$ ).

Plastic wound closure was performed in 75 (71.4%) patients Autodermoplasty of wounds with a split dermatome flap was performed in 64 (60.9%) patients in both groups. If there is a comparatively small wounds (up to 100 cm<sup>2</sup>) and sufficient reserves of the surrounding skin in 12 (11.5%) patients underwent wound plastic surgery with local tissues (Table 4, Fig. 3) 29 (28%) patients refused skin plastic surgery and were in satisfactory condition with granulating wounds were discharged for outpatient treatment.

Table 4

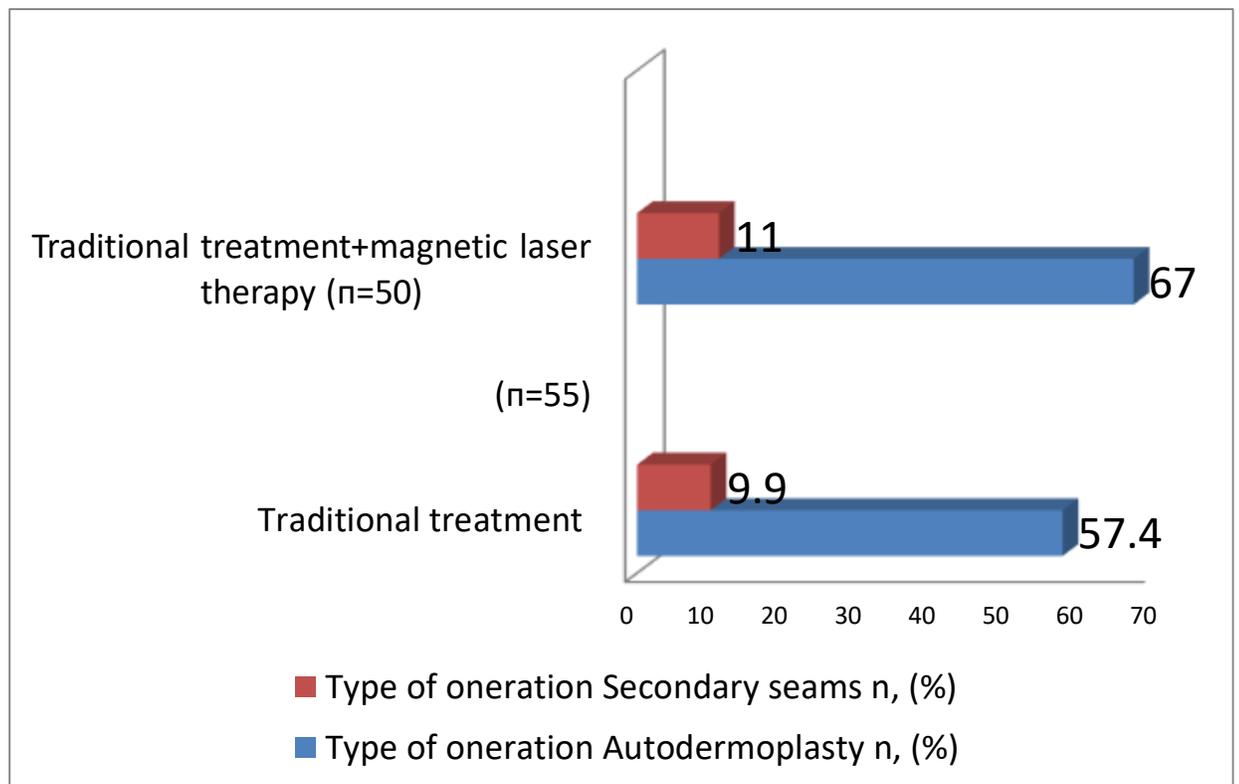
## Types of plastic surgery in groups

Patient groups	Type of operation		Total (n=105)
	Autodermoplasty n, (%)	Secondary seams n, (%)	
Traditional treatment (n=55)	32 (57,4%)	5 (9,9%)	37 (67,3%)
Traditional treatment+magnetic laser therapy (n=50)	33 (67%)	6(11%)	39 (78%)
Total (n=105)	65 (61,9%)	11 (10,5%)	76 (72,4%)

The grafts were taken with a dermatome under local anesthesia. Donor wounds were covered with gauze napkins soaked in 2% potassium permanganate solution. Skin grafts were transferred to granular wound surfaces, after which the wounds were covered with paraffin mesh or Mepitel Ag wound dressing.

Figure 3.

## Types of plastic surgery in groups



After the application of secondary sutures, the wounds healed without complications in all cases. With autodermoplasty, graft engraftment by 90-100% was observed in 48 (73.3%) patients, graft engraftment by 70-90% had grafts in 13 (19.5%) and 6 (9.2%) patients took root by 50-70%.

The use of a complex technique for treating patients with complicated forms of cellulitis with the use of magnetic laser therapy made it possible to reduce the duration of inpatient treatment by 1.3 times. In the main group, the dates treatment amounted to inpatient treatment  $20.3 \pm 1.5$  days and outpatient treatment  $5.7 \pm 0.6$  days, which is significantly shorter than with traditional treatment.

With traditional treatment, these periods were  $27.5 \pm 1.7$  days. inpatient treatment and  $8.1 \pm 1.2$  days of outpatient treatment. After discharge of patients from the hospital

outpatient treatment was short in all groups, but after traditional treatment, it terms were 1.4 times longer than in the group where magnetolaser was used therapy. The application of the developed technique contributed to the reduction the total period of treatment of patients by 1.35 times (Table 5, Fig 4).

Table 5.

Terms of treatment of patients with complicated forms of cellulitis in groups

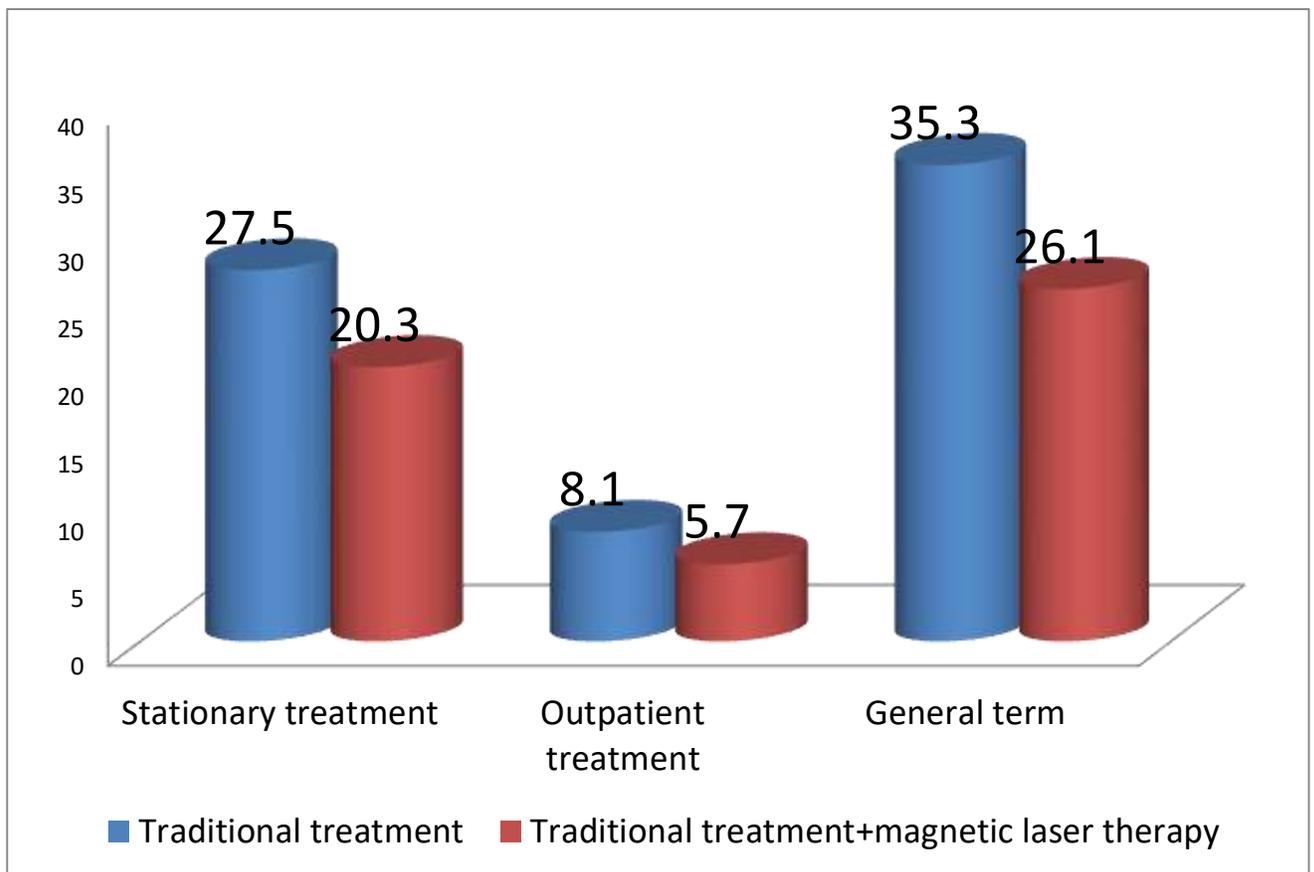
Patient groups	Stationary treatment	Outpatient treatment	General term
Traditional treatment	27,5±1,7	8,1±1,2	35,3±2,2
Traditional treatment+magnetic laser therapy	20,3± 1,5*	5,7± 0,6*	26,1±1,2*

Note \* - the reliability of the difference from the indicators of the group with traditional treatment ( $p < 0.001$ ).

Histological and histochemical study of biopsy specimens of wounds of patients with complicated forms of cellulitis before the start of treatment showed that the morphological picture consists in the formation of a purulent-necrotic exudate rich in microflora, pronounced microcirculatory disorders (intravascular stasis, microthrombi, leukostasis, endo- and perivasculitis, destruction and desquamation of the endothelium increased edema, abundant neutrophilic.

Figure 4.

Terms of treatment of patients with complicated forms of cellulitis in groups



infiltration, hemorrhages, dystrophic and necrotic cell changes. The phagocytic activity of neutrophils was sharply reduced, the macrophage reaction and proliferation of fibroblasts were inhibited, granulation tissue was absent or was found in the form of small foci and had an immature character. The wounds were characterized by a combination necrosis, purulent inflammation, immature and fibrosed granulation fabrics. Cytological examination of wound exudate showed that after the beginning of traditional treatment noted a delayed cleansing of wounds from bacterial infection and necrotic detritus, inhibition of the transition from incomplete phagocytosis to complete, from predominance dystrophic and necrotic forms of neutrophils to unchanged forms. This indicated the inhibition of the transition of necrotic the inflammatory phase of the

wound process into the inflammatory and reparative. A manifestation of this is a small number of macrophages with active phagocytic function and fibroblasts, as well as delaying processes epithelialization of wounds.

By the 7th day after the operation, there was insufficient cleansing wound surface from purulent-necrotic exudate, remained microcirculatory changes, edema, neutrophilic infiltration, lymphostasis and vasculitis. Inhibition of macrophage reaction in wounds delays the cleansing of the wound from decay products and microflora, and the production of cytokines that stimulate the proliferation of fibroblasts and collagen synthesis. This inhibits the formation and maturation of the granulation tissue, the development of marginal epithelialization of the wound surface, which is noted in biopsies only by the 14th day. Regenerating epithelium is immature, poorly connected to the underlying tissue and easily rejected.

The use of magnetic laser therapy for the treatment of patients with complicated forms of cellulitis accelerates the course of the wound process. By

data of cytological research is faster (already by 3 day) cleansing wounds from microflora, which was the result of the action magnetic laser therapy with an indirect bactericidal effect, due to the activation of microflora phagocytosis by neutrophils. The wound surface is cleared of necrotic detritus and fibrin, which is associated with the activation by macrophages of phagocytosis of cell decay products and fabrics. Activation of the macrophage response on the 3rd-7th day and an increase in the number of fibroblasts reflects the acceleration of reparative processes. So Thus, by the 7th day, the cytograms of the wound exudate acquire the type inflammatory and inflammatory-reparative. At the same time, there was a decrease in the role of passive mechanisms of regulation of microcirculation associated with heart rhythm and respiratory activity. All this led to an increase in the index microcirculation efficiency on average up to  $1.84 \pm 0.7$ . Values stress tests also indicated a significant recovery reserve properties of skin microvessels, normalization of their reactivity, alignment of

the venulo-arteriolar relationship, the RCC was 100-350%,  $T_{1/2}$  - 20-40 sec. Normalization of microcirculation indices by 14 the day of treatment also indicated the readiness of the wound surface for surgical closure.

Thus, our proposed method of treating patients complicated forms of cellulitis with the use of magnetic laser therapy, is highly effective and allows you to shorten the treatment time and rehabilitation of patients, the number of drugs and dressings, which determines a significant social economical effect.

## CONCLUSIONS

1 The method of complex treatment of patients with complicated forms cellulitis with the use of magnetic laser therapy is pathogenetically grounded, highly effective, providing a 1.35-fold reduction in the treatment time.

2 According to clinical studies, magnetic laser therapy promotes rapid cleansing of the wound surface in patients with complicated forms of cellulitis from purulent-necrotic detritus, increased phagocytosis, normalization of microcirculation, weakening of inflammatory infiltration, increased macrophage response and proliferation of fibroblasts and stimulation of angiogenesis and maturation. and wound epithelialization. These processes proceed 1.5 - 2 times faster in comparison with the comparable group.

3. Application of magnetic laser therapy in complex treatment patients with complicated forms of cellulitis activates the transcapillary exchange in the wound area, contributes to the restoration of structure and function microvasculature of the affected area by increasing myogenic activity of smooth muscle cells of arterioles and precapillaries, and normalization of arterio-venous relationships, which provides efficiency of blood flow.

4 The developed method of complex treatment of complicated forms cellulitis, based on the use of magnetic laser therapy, according to clinical research in its therapeutic effectiveness is significantly superior to traditional therapy and can be recommended for implementation in wide clinical practice.

## PRACTICAL RECOMMENDATIONS

The arsenal of modern means of complex treatment of patients complicated forms of cellulitis should be advised to include magnetic laser therapy. In the postoperative period, from the first day after the operation, sessions of magnetic laser therapy are performed daily. To carry out magnetic laser therapy, a semiconductor laser therapeutic apparatus with magnetic attachments is used. Exposure parameters: wavelength 0.89  $\mu\text{m}$ , power 10 W, frequency 80 Hz, constant magnetic field 25 mT, exposure per zone 2 min. The points of influence are contact - projections of large vessels, regional lymph nodes, posterior muscle group of the lower leg, labile - wound surface (when localized on the lower extremities). When the process is localized on the upper limb, the impact point is the projection of large vessels, regional lymph nodes and a wound. The course includes 10 procedures. Dressings with antiseptics and hydrophilic ointments are used to cleanse ulcers from purulent-necrotic masses.

After cleansing the wounds from purulent-necrotic masses, the appearance of granulations and marginal epithelialization, with extensive wound defects, plastic closure of wounds is shown - autodermoplasty, or closure with local tissues.

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