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Tactics of surgical treatment of deep intermuscular gluteal region phlegmons

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Abstract

Purpose. The purpose is to improve the results of treatment of patients with phlegmon of the gluteal region soft tissues by diagnosing the stage of tissue hypertension and determining the tactics of surgical treatment depending on this indicator.

Materials and methods. Clinical studies were performed on 74 patients suffering from phlegmon of the gluteal region. All the patients were divided into 2 groups: in the main group (as opposed to the control group), acute tissue hypertension syndrome was diagnosed and decompressive fasciotomy was performed in tissue hypertension (30–35 mm Hg) (patent). The authors performed ultrasound cavitation and ozone therapy of a purulent wound.

Results. With phlegmon of the gluteal region of soft tissues, an increase in tissue pressure by 25% above the norm is an indication for fasciotomy in the area of fascial nodes. The time of purulent wound cleaning against the background of normal tissue pressure (8–10 mm Hg) of the surgery in patients of the main group was reduced to 5 days (8 days in the control). In the long-term (0.5–1 years), good results were obtained in 92.8% of patients in the main group (64.7% in the control group).

Conclusion. The developed tactics of treatment of patients with phlegmon of the soft tissues of the gluteal region are highly effective due to the development and application of new technologies for the diagnosis and treatment of tissue hypertension.

Keywords: phlegmon, tissue hypertension syndrome, fasciotomy, surgical treatment.

Introduction. The analysis of Russian and foreign scientific literature demonstrates that the difficulties of treating pyoinflammatory soft tissue diseases in modern conditions are due to several reasons. These include late presentation, changes in the nature of pathogenic microflora with increasing resistance to the antibiotics used, unreasonably long conservative treatment, incorrect or insufficiently radical primary surgical intervention. At the same time, surgeons often do not take into account the fact that one of the features of pyoinflammatory diseases is their property of spreading through cellular spaces and fascial crevices with the formation of purulent congestion [1, 2].

In addition, about 25–40% of the indicated contingent of surgical patients suffer from complicated forms of a deep intermuscular phlegmon of the extremities in the form of developed acute tissue hypertension syndrome (ATHS) [3].

However, the authors did not find any literature data justifying the differentiated tactics of surgical treatment in relation to abscesses and phlegmons, taking into account the stage of ATHS development. Until now, in surgical practice, the early diagnosis of tissue hypertension syndrome is based on subjective, uninformative clinical data. Therefore, a surgeon is faced with the task of not only carrying out broad and anatomically sound drainage of the inflammatory focus but also eliminating the threat of ATHS development.

It is possible to develop and justify a therapeutic and diagnostic algorithm for surgical treatment of patients with phlegmon of the gluteal region soft tissues, complicated by hypertension syndrome, only by means of taking into account the stage of its development. This requires careful anatomical and experimental studies, followed by a comparison of the results obtained and the clinical material.

Purpose of the research. The purpose of this research is to improve the results of treatment of patients suffering from phlegmon of the gluteal region soft tissues by diagnosing

the stage of tissue hypertension and determining, depending on this indicator, the surgical treatment tactics.

Material and methods. The analysis of clinical observations is based on the complex treatment and studying the surgery results in 74 patients suffering from phlegmon of the gluteal region. The comparative treatment results of two patients' groups with different types of diagnostic techniques and surgical interventions are also presented. The main group (38 patients) included patients whose diagnosis was supplemented by ultrasound methods and measurement of tissue pressure [4] followed by fasciotomy of the corresponding muscle cases, in accordance with the indications for treatment. Conventional treatment is supplemented by ultrasound cavitation of the purulent focus, as well as ozone therapy. The control group (36 patients) underwent autopsy and revision of the purulent focus, its sanitation and drainage. No treatment of hypertension syndrome was performed. In both groups of patients, surgical treatment was supplemented with drug therapy according to the generally accepted scheme. Among 74 patients, there were 43 males (58.1%) and 31 females (41.9%).

Together with a thorough study of the anamnesis according to the survey data, a complex of examinations was conducted, the purpose of which was to establish the correct diagnosis, the nature and prevalence of the inflammatory process. Therefore, the survey data were decisive in assessing the timing, scope of surgery and further treatment.

1. Clinical research methods: General blood analysis; general urine analysis; biochemical blood analysis.
2. Microbiological methods of research.
3. Immunological methods of research.
4. Clinical and physiological methods of research: The determination of tissue pressure was carried out by means of the device "Stryker" REF, which allows measuring the tissue pressure in a healthy and affected limb simultaneously and non-invasively, as well as diagnosing hypertension syndrome by the ratio of these pressures (patent) [5].
5. In order to identify the role of the microbial factor and determine the timing of wound cleaning, the contents were seeded and the microbial contamination was detected. The criterion for the completion of the first treatment stage and the indication for the second one was a decrease in the microbial contamination of the wound with CFU 10^5 of microbial bodies in 1 gram of tissue and the cytological picture of the regeneration phase of the wound process.

The ultrasound treatment of purulent gluteal region wounds was performed by means of a device for surgical rehabilitation of biological objects URSK-7N.

As for local sanitation, cooled ozonated solutions were used, depending on the phase of the wound process. In case of severe endogenous intoxication, systemic (intravenous) ozone therapy was performed.

Results. While studying the clinical course of a phlegmon of the gluteal region soft tissues in the age aspect, all the patients were divided into 3 subgroups. The first subgroup (20 patients) included patients under 35 years of age, the second subgroup (34 patients) – 35–45 years of age, and the third subgroup (20 patients) – over 45 years of age.

In the case of patients under 35 years (20 patients), local and general pathological symptoms increased significantly faster than in patients of older age groups, which is associated with high body reactivity. The pyoinflammatory process quickly spreads and becomes diffuse, not only occupying all the cellular layers of one fascial segment but also passing to the fiber of another segment.

These patients were admitted to the hospital in mostly moderate or severe conditions. The body temperature reached 39.5–40.0 °C. Its fluctuations during the day (in the

anamnesis) were about 2–3 °C. The intoxication was full-blown. Most of the patients also suffered from nausea, dizziness, and shivering attacks.

In the second age group (34 patients), which included patients aged 35–45 years, the clinical course of pyoinflammatory processes of the studied localization was characterized by a wide variety: very rapid, with severe general and local disorders, moderately active or sluggish, and prolonged without significant general and local clinical manifestations with many complications.

The analysis of the disease course in patients older than 60 years (3 patients) showed that the pyoinflammatory process proceeded according to the hypoergic type with the spread of the abscess throughout the cellular space of the area. This is primarily determined by the intracellular and immunological changes that have occurred in the elderly group. All patients of this age group were admitted to the hospital at a late date (10–12 days after the disease onset), which is quite understandable by slowing down the local and general reaction to the introduction of microflora.

On the day of admission, body temperature was measured in all the patients, a general blood test and biochemical blood test were taken, and coagulation testing was carried out (for an objective assessment of the patients' condition). As for the laboratory data, the most informative and reliable were the indicators of the general blood test and blood biochemistry. The immunological parameters were analyzed for T- and B-systems of immunity. All these indicators were recounted in dynamics on the 3rd-4th, 7th-8th, and 10th-12th days of treatment.

In patients of all age subgroups with pyoinflammatory processes of soft tissues, a decrease in hemoglobin and blood protein, a decrease in the number of red blood cells, leukocytosis, a shift of the leukocyte formula to the left up to immature forms, and an increase in erythrocyte sedimentation rate (ESR) could be detected. Some patients were found to have toxic white blood cell granularity (up to +++).

It should be noted that in patients over 60 years of age, against the background of a decrease in hemoglobin, the number of red blood cells and an increase in ESR, changes in white blood cells were less pronounced anyway. The number of white blood cells was not more than $16 \times 10^9/l$, and in 2 cases, there was lymphopenia with a sharp shift of the formula to the left.

Therefore, 136 strains of microorganisms were isolated from the foci of surgical infection of the gluteal region soft tissues. The spectrum of the isolated microflora was dominated by enterobacteria, accounting for 46.1%, and representatives of the *Staphylococcus* genus – 33.6%. There were also *Enterococcus faecalis*, *Aerococcus viridans*, etc. – 13.5% and gram-negative bacteria, represented by *Pseudomonas aeruginosa* (10.4%), but less common. In 28 patients, pathogens of surgical infection were isolated in a monoculture, mainly staphylococci and streptococci. The associations of microorganisms were observed in 36.5% of patients. The associations of staphylococci and enterobacteria, staphylococci and streptococci, as well as various representatives of the Enterobacteriaceae family, were more common. In contrast to the above cases, 29.7% of patients demonstrated the dynamics of the microbial landscape of surgical infection foci. If at the beginning of the disease, staphylococci and streptococci predominated, then during the infectious process, their elimination was observed, followed by replacement with enterobacteria, the frequency of which increased by about 2 times during the disease.

The choice of surgical aid, the result of surgical patients' treatment, postoperative corrective therapy, and the postoperative course directly depended on the severity of the course of the pathological process on an individual index scale.

In all 74 patients with deep gluteal region phlegmon, surgery was performed in the next few hours (1–5 hours) from the moment of the patient's admission to the septic surgery department. The surgery was performed under general anesthesia with the use of adequate incisions. The patients of the main group (n=38) underwent purulent cavity sanitation with antiseptic solutions and ultrasound treatment of wounds in 0.05% chlorhexidine solution. In

the control group (n=36), the purulent cavity was treated only with antiseptic solutions (3% solution of hydrogen peroxide and 0.05% solution of aqueous chlorhexidine).

The preoperative preparation, especially in patients with moderate and severe course of the pathological process, according to the score scale, may be considered as an important factor. First of all, it provides for a reduction in the degree of hypovolemia and dehydration of the body.

In the treatment of patients with phlegmon after surgery, ointments based on polyethylene oxide (levomecol, dioxicol, levosin) were used. After cleaning the wounds and the appearance of granulations, foam antiseptics such as “Dioxysol” or “Olazol” were used. When the width of the wounds was not more than 3 cm, “Atrauian” ointment was used.

The stage of rehabilitation treatment was to close the wound defects. The recovery treatment stage was started in strict accordance with the indicators of microbial contamination of wounds (no more than 10^4 – 10^5 CFU/g of tissue).

It was found that acute inflammatory processes of soft tissues occurred together with increased tissue pressure. At the same time, the degree of the increase in tissue pressure depended both on the nature of the structure of the fascial case and on the duration of the disease. So, pyoinflammatory processes localized in the gluteal region are usually accompanied by a greater rise in tissue pressure than similar processes in the thigh and lower leg.

Clinical analysis of the medical records of patients with different disease duration showed that if the autopsy of the pathological focus was not carried out until 3–5 days, then patients usually had symptoms, expressed in an increase in the intensity of pain, an increased need for analgesics, and local soreness in the area of the concerned fascial bed of the gluteal region with passive movements in the fingers of the limb. In 9 patients (the opening of the abscess was performed 7 days after the disease), there was a violation of the sensitivity of the limb on the side of the surgery. At the same time, the value of the tissue pressure was 55–60% higher than the initial level. In addition, all these patients belonged to the second mature and elderly age. After opening the abscess, the value of tissue pressure in these patients decreased, but even at the time of discharge from the hospital, it was 15–20% higher than the initial level. The highest rates of interstitial pressure were observed in patients aged 20–45 years, in which the clinical manifestation of the disease was characterized by a more rapid course. After opening the abscess and against the background of fasciotomy, the gradient of tissue pressure in patients of this age group rapidly decreased and normalized on the 7th–8th day.

The authors reckon that while establishing a diagnosis that accompanies a pyoinflammatory disease, such as acute hypertension syndrome, the only effective treatment besides opening the abscess cavity is fasciotomy of the concerned fascial formations of the gluteal region. First of all, these include the upper, medial, sciatic, and lower fascial angles formed by the processes of the fascia of the gluteal muscles to the bone.

The authors performed fasciotomy in 33 out of 38 patients in the main observation group (87.1%). Fasciotomy was not performed in patients of the control clinical group. In the postoperative period, 29 out of 36 patients (80.0%) suffered from complications in the form of paresthesia and myofascial pain trigger. Within 180 days after the operation, the tissue pressure was increased to 25 mm Hg.

The use of ozone therapy in complex treatment provides a bactericidal, detoxifying, adaptogenic, and immunomodulatory effect, which allows improving the results of treatment of patients. The results obtained allow the authors to recommend ozone therapy (as an additional method (25 mcg/l)) daily in the first phase of the wound process. In the case of severe endogenous intoxication, local ozone therapy with a lower (5 mcg/l) concentration in the second phase can also be recommended. The use of the de-escalation principle of antibiotic therapy may also improve the results of treatment of patients with deep gluteal region phlegmon, especially in the extremely severe course of the pathological process and the manifestation of the syndrome of a systemic inflammatory reaction of the body.

Conclusion. In the case of a deep intermuscular phlegmon of the gluteal region, an increase in intra-tissue pressure is observed in 94.8% of cases, and most of them (87.1%) develop tissue hypertension syndrome (compartment syndrome). Therefore, fasciotomy of the concerned gluteal region fascial structures may be considered as the pathogenetically justified method of treatment, against the background of normalization of the tissue pressure index (8–10 mm Hg). The use of ultrasound treatment of a purulent wound and daily irrigation with ozonated solutions at a concentration of at least 20 mcg/l in the postoperative period in patients with deep phlegmon of the gluteal region accelerates the processes of wound cleansing by 1.5–2.5 times. In this case, it becomes possible to close the wounds early with primary delayed sutures.

A comprehensive approach to the treatment of patients with intermuscular phlegmon of the gluteal region allows achieving good results earlier after treatment in 83.3% of patients (55.0% in the control group), while reducing the length of hospital stay to 12.5 ± 2.5 days (19.5 ± 2.5 days in the control group), and in the long term in 92.8% of patients (64.7% in the control group).

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Thermal and shock-wave effects of HIFU - effects on tissue-equivalent phantoms

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Abstract

The nature of changes in the structure of the PAG-3 biophantome under the action of HIFU indicates the significance of shock-wave shifts involved in the formation of the heat pattern and the destruction zone. The thermal effect is accompanied by the accumulation of thermal energy, the limitation of the thermal field, which predetermines the therapeutic efficiency of focused ultrasound exposure, however, it is advisable to take into account the role of mechanical effects in focused ultrasound therapy.

Key words: high-intensity focused ultrasound HIFU, thermal patterns, shock-wave effects, mechanical microflows, biophantom, PAG3, thermal ablation zones.

The propagation of high-intensity focused ultrasonic vibrations (HIFU) in biological tissues forms an acoustic field [1–3] in the form of a set of spatio-temporal thermal and mechanical characteristics of distributions with the formation of interference maxima in local zones due to superpositions of acoustic waves generating shock-wave and thermal effects.

Obviously, the response of biological tissues to such influences should be determined, on the one hand, by the nature of energy distribution and the degree of manifestation of wave