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ORGANIZATION OF STAGE REHABILITATION OF SERVICEMEN WITH GUNSHOT DEFECTS OF SOFT TISSUES AT THE LEVELS OF MEDICAL CARE

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Ключевые слова: *этапная реабилитация, военнослужащие, огнестрельные ранения, дефекты мягких тканей*

Abstract. Organization of stage rehabilitation of servicemen with gunshot defects of soft tissues at the levels of medical care. Babov K.D., Khomenko I.P., Tertyshnyi S.V., Babova I.K., Vastianov R.S. *Building a modern system of rehabilitation of servicemen in Ukraine is an integral part of providing medical care in armed conflict. Rehabilitation of servicemen after gunshot defects of soft tissues of the lower extremities is a common but difficult problem for surgical and rehabilitation teams. The process of rehabilitation requires the implementation of certain methodological provisions. At present, medical care for servicemen is a four-levels' one. Rehabilitation service is provided at the third and fourth levels of medical care. The aim of the study was to improve the quality of medical care for servicemen after gunshot defects of soft tissues of the lower extremities by introducing a system of staged rehabilitation. Organizational and methodological bases of the system of staged rehabilitation of wounded servicemen with gunshot defects of soft tissues at different levels of medical care have been developed. Two models of rehabilitation depending on the severity of the injury and the tactics of surgical treatment are proposed. The division of the stage of early sanatorium rehabilitation for the wounded with severe gunshot defects of the soft tissues depending on the stage of surgical treatment and the formation of a "skin flap" is justified. The introduction of the proposed models of rehabilitation of the wounded with soft tissue defects in the practice of early sanatorium rehabilitation will provide increasing of medical care quality.*

Реферат. Организация этапной реабилитации военнослужащих с огнестрельными дефектами мягких тканей на уровнях предоставления медицинской помощи. Бабов К.Д., Хоменко И.П., Тертышный С.В., Бабова И.К., Вастьянов Р.С. *Построение современной системы реабилитации военнослужащих в Украине является неотъемлемой составляющей оказания медицинской помощи в условиях вооруженного конфликта. Реабилитация военнослужащих после огнестрельных дефектов мягких тканей (ОДМТ) нижних конечностей является распространенной, но сложной проблемой для хирургической и реабилитационной команд. Процесс восстановительного лечения требует выполнения определенных методологических положений. В настоящее время медицинская помощь военнослужащим является четырехуровневой. Реабилитационные мероприятия предусмотрены на третьем и четвертом уровне оказания медицинской помощи. Целью исследования было повышение качества оказания медицинской помощи военнослужащим после ОДМТ. Разработаны организационно-методические основы системы этапной реабилитации раненых военнослужащих с ОДМТ на разных уровнях оказания медицинской помощи. Предложены две модели реабилитации в зависимости от тяжести ранения и тактики хирургического лечения. Обоснованно разделение этапа ранней санаторно-курортной реабилитации раненых с тяжелыми ОДМТ в зависимости от этапного хирургического лечения и формирования «кожного лоскута». Внедрение предложенных моделей реабилитации раненых с ОДМТ в практику ранней санаторной реабилитации способствует повышению качества оказания медицинской помощи военнослужащим.*

Creating a modern system of rehabilitation of servicemen in Ukraine is an integral part of providing medical care in armed conflict, one of the guiding principles of the "Military Medical Doctrine of Ukraine" [4], "Annual National Program under the auspices of the NATO-Ukraine Commission for 2021 "[11] and is fully consistent with the Laws of Ukraine "On rehabilitation in the field of health care" [8] and "On social and legal protection of servicemen and members of their families" [9].

Rehabilitation of servicemen after gunshot wounds with soft tissue defects of the lower extremities is a common but difficult problem for surgical and rehabilitation teams. The process of restorative treatment requires the implementation of certain methodological provisions. Currently, four levels of medical care for servicemen of the Armed Forces of Ukraine (AFU) have been proposed [6]. Rehabilitation measures are provided at the fourth level, they are provided in accordance with the available material and technical base of the health care institution, staff, etc., where the wounded undergo treatment. At the same time, the provision of medical rehabilitation services in sanatoriums of the Armed Forces of Ukraine, in our opinion, can be attributed to the fourth level.

The fourth level is formed and implemented at the strategic level through military medical clinical centers, health care facilities of state and municipal property and involves the provision of highly specialized medical care using high-tech equipment and / or specialized medical procedures of high complexity. It is at this level that the goal and objectives of rehabilitating the wounded must be fully realized, i.e. return to military service or the issue of demobilization resolved. At this level, rehabilitation care is provided in acute, post-acute and long-term rehabilitation periods in inpatient (the hospital where surgical treatment was performed) and outpatient conditions. Rehabilitation measures in sanatorium-resort conditions in post-acute and long-term rehabilitation periods for wounded servicemen are implemented exclusively in sanatorium-resort establishments of the Armed Forces of Ukraine [3, 7]: Medical rehabilitation and sanatorium treatment centers "Pushcha Vodytsia", "Truskavetsky" "Odessa"; "Khmilnyk" Central Military Clinical Sanatorium; Central Military Sanatorium "Prymorsky"; sanatorium departments of the

Military Medical Clinical Center of the Central Region and the Southern Region.

The aim of the study is to improve the quality of medical care for servicemen after gunshot wounds with soft tissue defects of the lower extremities by developing models of staged rehabilitation.

According to the statistical analysis of the nature of injuries in the wounded, who were admitted to the Military Medical Clinical Center of the Southern Region (Odesa), in the structure of sanitary losses of the surgical profile, the proportion of wounded with gunshot defects of soft tissues (GDST) is 16.7%, according to the localization, limb injuries make up 74.9%, moderate – 60.2% and large – 33.7% injuries prevail, the main causes are shrapnel (45.6%) and bullet (38.0 %) injuries, mine-blast ones occur in 16.4%; multiple (44.2%) surgical trauma prevails.

The process of GDST reconstruction is multi-stage and requires a number of surgical interventions at different times at different levels of care. Rehabilitation measures for such patients are also different. Based on the statistical observations on the location, severity and prevalence of injuries, we identified three groups of the wounded for further development of rehabilitation models in sanatorium conditions, to assess the severity of injuries, the Admission trauma scale (AdTS) was used [1]:

1) wounded with a non-severe injury (GDST of medium size, AdTS <5 points, perfusion index >4%) after full surgical care with primary and final correction of the injury;

2) wounded with severe trauma (GDST of large size, AdTS 5-9 points, perfusion index 2-4%);

3) wounded with extremely severe trauma (GDST of mega large size, AdTS >9 points, perfusion index <2%).

Wound healing is a complex cascade of events that restores the integrity of the skin by replacing damaged cells and tissues, consisting of four phases: hemostasis, inflammation, proliferation and remodeling [12]. At all stages of medical care and rehabilitation, various means and methods are used: physical rehabilitation, methods of hardware physiotherapy, natural medical resources (therapeutic mud, mineral water) of sanatoriums, methods of psychotherapy, etc.

The general purpose of rehabilitation of the wounded is: prevention of infectious complications; prevention of keloid and hypertrophic scarring; preventing the development of immobilization contractures; improving the quality of life; return to work and active social life as soon as possible.

For the wounded servicemen of the first group we developed a three-stage model of rehabilitation (Fig. 1), when the wounded began rehabilitation measures in the acute period in the hospital and under certain conditions they were immediately transferred to a specialized department of the sanatorium and, if necessary, outpatient rehabilitation.

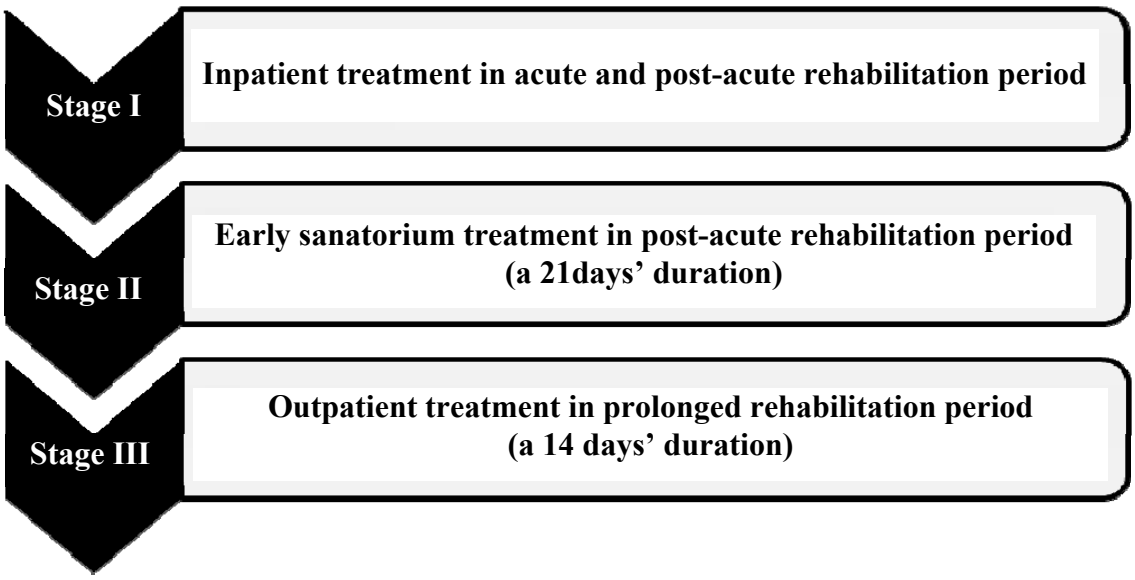

Fig. 1. Model of rehabilitation of the first group of servicemen with gunshot defects of soft tissues

For the wounded of the second group, we proposed a four-stage model of rehabilitation (Fig. 2). In particular, we propose to divide the stage of sanatorium rehabilitation into an early sanatorium, which is provided in the post-acute rehabilitation period and, accordingly, consists of two parts, and postponed which is provided in the long rehabilitation period, in particular in the development of complications such as scarring contractures, keloid scars, etc.

The wounded of the third group also received rehabilitation treatment according to the four-stage model, but in the outpatient phase (stage III) their rehabilitation potential was additionally calculated and doctors of the Military Medical Commission (MMC) decided on the possibility of their further military service.

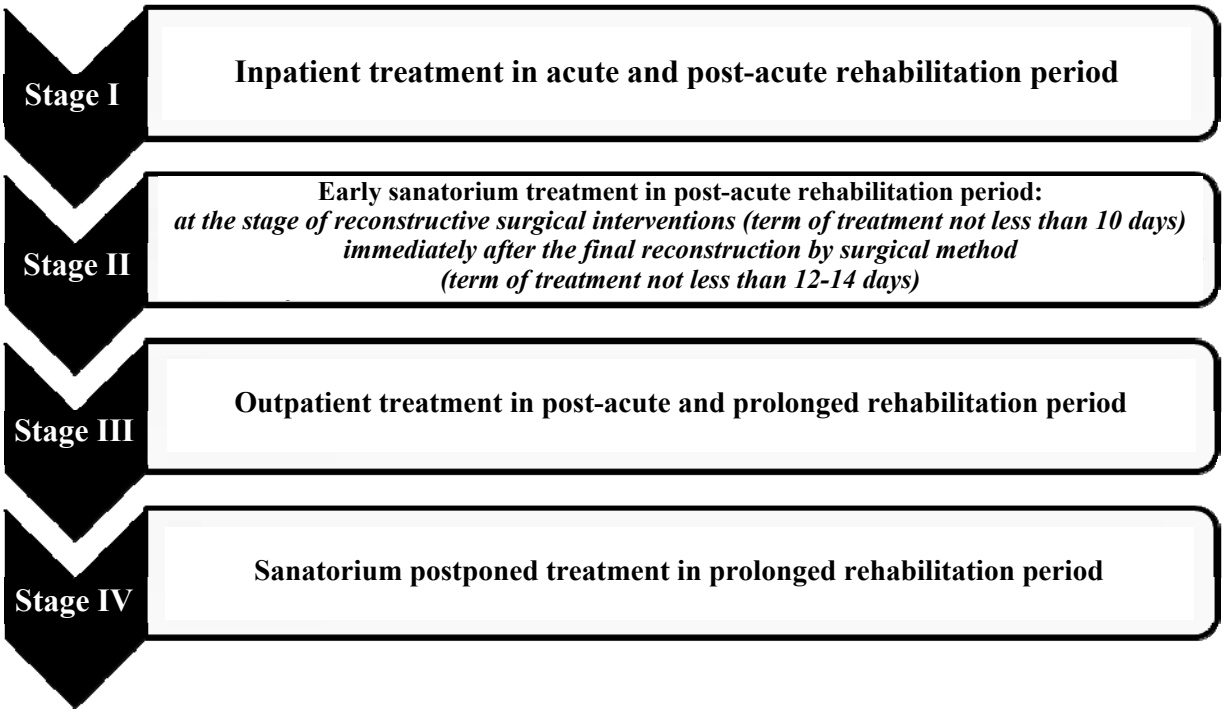

Fig. 2. Model of rehabilitation of the second group of servicemen with gunshot defects of soft tissues

Immediately after surgery, all the wounded are examined by members of the multidisciplinary rehabilitation team (MDRT) in order to develop an individual rehabilitation plan. The composition and relationships of MDRT were developed by us for sanatoriums, based on the Law of Ukraine "On Rehabilitation in Health Care" [8] (Fig. 3).

In our opinion, the most important thing is to maintain the relationship between doctors who provided care to patients in the acute period at the inpatient stage of treatment, and doctors at the stage of sanatorium rehabilitation. Successful formation of MDRTs is the key to effective rehabilitation of the wounded.

To facilitate the process of obtaining medical information about the condition of the wounded between inpatient health care facilities, MMC and sanatoriums that provide rehabilitation services, it is advisable to create an electronic Register of Wounded Soldiers. However, this issue is difficult, given the special need to adhere to the principles of protection of personal data of the patient.

The inpatient rehabilitation phase is carried out in acute and post-acute rehabilitation periods immediately after surgical treatment in a health care facility where specialized or highly specialized surgical care was provided. This period is the entire stay of the wounded in the hospital from the first hours after surgery. The purpose of this stage is: abatement; limiting and reducing the volume of inflammatory exudate; reduction of metabolic needs of tissues; protection of damaged tissues from further damage; protection of tissues formed from rupture; ensuring the growth of new tissue and the

restoration of fibers; maintenance of the general condition of the cardiovascular and musculoskeletal systems/normal activity; prevention of infectious complications, etc. Medication is prescribed to prevent postoperative complications. The PRICE principle is used for the management of patients in the early stages (up to 72 hours after surgery) after soft tissue injuries [12]: protection: defense (bandaging, supporting bandages, limiting the axial load on the injured limb, crutches); rest: calm (relative rest compared to normal movements); ice: cold (use of various cooling agents for therapeutic purposes); compression: compression (to reduce exudate and pain); elevation: elevation (helps to reduce bleeding, edema, pain).

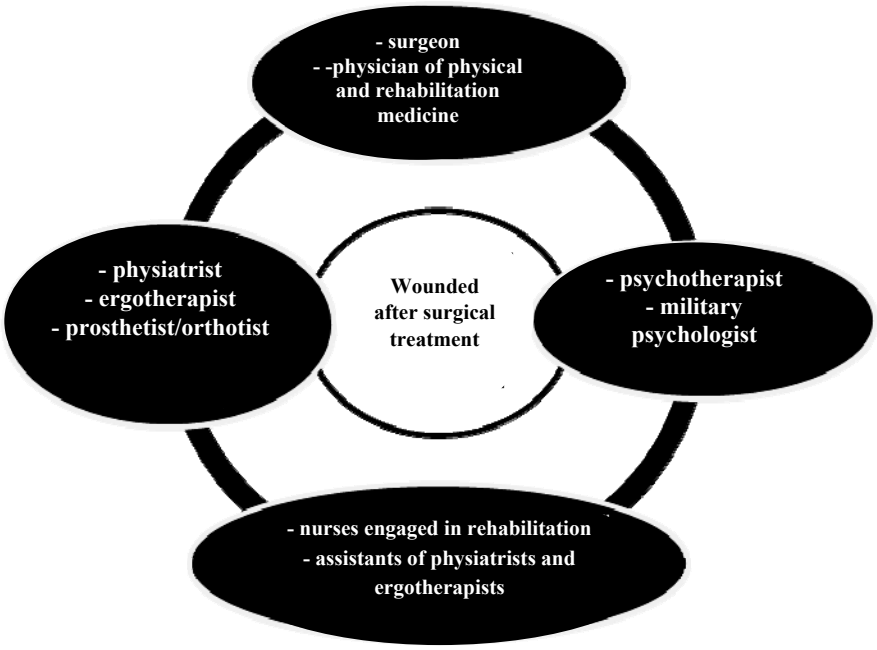

Fig. 3. Composition and relationships of multidisciplinary rehabilitation team

Starting from days 2-3 after surgery (when the stage of tissue proliferation begins), the tasks of rehabilitation are: abatement subsidence of edema; decrease of local temperature; prevention of further tissue damage; protection of new tissues formed; support and increase of muscle strength, coordination; function improvement.

For the wounded of the first group, the sanatorium stage of rehabilitation may be final before returning to military service.

The patients of the second group underwent early sanatorium rehabilitation in two stages, which was due to the staged surgical treatment of the soft tissue defect.

The early sanatorium stage, according to our proposed model, is divided into two time-related sub-stages:

1) the wounded person is referred to the specialized rehabilitation department of the sanatorium-resort institution of the Armed Forces of Ukraine immediately after the reconstructive surgical interventions at the stage of formation of the "skin flap";

2) the wounded person is referred to the specialized rehabilitation department of the sanatorium and resort institution of the Armed Forces of Ukraine immediately after the final reconstructive surgical interventions.

It is recommended to refer the wounded servicemen of the first and second groups to the early sanatorium rehabilitation within 10 or more days after surgical treatment, in the phase of tissue remodeling, when high activity of fibroblasts, collagen formation, replacement of type III collagen fibers the I, resorption of old and and storage of new fibrosis tissue, compression of scar tissue is observed [12]. This period is very important for the formation of normal scar tissue.

The purpose of early sanatorium rehabilitation is: to promote collagen growth and tissue regeneration;

increase in the volume of active, passive and auxiliary movements; increase in muscle strength, coordination; maximum recovery of function. Principles of prescribing means of physical rehabilitation: the main means of therapeutic exercise are physical exercises, the nature of which is determined by the patient's motor regime and the peculiarities of the disease. In the treatment of the wounded tonic, breathing and special exercises are used. The main condition is their regular and long-term use with sufficient intensity of general and local influence. Rehabilitation protocols have been proposed by the US military medical team, which include early loading of the injured limb, continuous passive movement in the joints, psychosocial intervention and multimodal pain treatment [15].

There are a number of evidence-based studies on the use of hardware physiotherapy: low-intensity laser therapy in the rehabilitation of wounds, soft tissue injuries, burns, diabetic foot ulcers [13]; hyperbaric oxygenation, laser therapy, shock wave therapy in chronic processes, photodynamic therapy, UV therapy [14]. The optimal method of physiotherapy is chosen taking into account risk factors, wound type, previous therapy.

The peculiarity of the appointment of hardware physiotherapy in the wounded servicemen with soft tissue defects is the possible presence of metal fragments in the wound and soft tissues that could not be removed surgically. Today, the presence of metal structures, clamps and fragments are not contraindications for the appointment of most types of hardware physiotherapy. Contraindicated for use in the presence of metal in the area of action are high-frequency magnetic therapy (inductothermy), ultra-high-frequency electrotherapy (decimeter-wave and centimeter-wave therapy, ultra-high-frequency therapy by transverse method) [2], due to the deep penetration and local heating of the metal located in the area of their action.

When prescribing methods of hardware physiotherapy, a syndromic-pathogenetic approach is used, with the isolation of leading dysfunctions and syndromes that need to be influenced [5]: to enhance tissue metabolism: ultrasound therapy; trophism and local blood flow in tissues: neuroelectric stimulation, non-selective phototherapy; reduction of edema and pain: local air cryotherapy; enhancement of tissue metabolism: low-intensity laser therapy.

At the long-term stage of rehabilitation, in particular in the formation of scar contractures, natural healing resources of sanatoriums are widely used, including balneotherapy with mineral waters (hydrogen sulfide, radon, etc.), hydrotherapy and thalassotherapy (sea bathing), peloid treatment.

The use of physical methods of scar correction depends on their nature [5]. At atrophic and hypotrophic scars it is applied: trophostimulating methods: low-frequency electrotherapy, infrared laser therapy, local darsonvalization, local cryotherapy, ultraphonophoresis; vasodilators: massage, applying heat compress, electrophoresis of vasoactive drugs. At hypertrophic and colloidal scars, the following is used: fibromodeling methods: electrophoresis with enzyme preparations (lidase, papain (caripain); preparations destructing fibrosis: ultraphonophoresis with enzymes and corticosteroids, electrophoresis with preparations destructing fibrosis, compresses with dimexidum and enzymes; antipruritics; electrophoresis with antihistamines and calcium ions, local darsonvalization.

Rehabilitation of servicemen in sanatorium-resort conditions contributes not only to the restoration of functional capacity, but also to disturbed psychological phenomena characteristic of post-traumatic stress disorder (PTSD) [10].

According to the proposed models, we have developed a pilot project of staged rehabilitation of servicemen after the reconstruction of the GDST of the lower extremities in sanatorium conditions. The Center for Medical Rehabilitation and Sanatorium Treatment "Odessa" of the Armed Forces of Ukraine was chosen as the basis for the pilot project due to its territorial proximity to the Military Medical Clinical Center of the Southern Region. This allows involving surgeons to MDRT, as well as tech-heavy material and technical resources. Implementation of staged rehabilitation measures within the project is envisaged according to the following algorithm:

1. Hospitals of the Armed Forces – providing surgical care.
2. Military Medical Clinical Center of the Southern Region of the Armed Forces of Ukraine – continuation of surgical treatment (reconstructive plastic surgery).
3. Military Medical Commission – referral to sanatorium rehabilitation at the stage of reconstructive surgery.
4. Center for Medical Rehabilitation and Sanatorium Treatment "Odessa" of the Armed Forces of Ukraine – early postoperative rehabilitation at the stage of formation of the "skin flap".
5. Military Medical Clinical Center of the Southern Region of the Armed Forces of Ukraine - continuation of surgical treatment.
6. Military Medical Commission – referral to sanatorium rehabilitation after the final surgical intervention.
7. Center for Medical Rehabilitation and Sanatorium Treatment "Odessa" of the Armed Forces of

Ukraine – postoperative rehabilitation after the final surgical treatment.

8. Military Medical Commission – restoration of function and return to military service / disability.

CONCLUSIONS

1. Organizational and methodological bases of the system of staged rehabilitation of the wounded servicemen with soft tissue defects at different levels of medical care have been developed. Two models of rehabilitation have been proposed, depending on the severity of the injury and the tactics of surgical treatment. It is proposed to divide the stage of early sanatorium rehabilitation for the wounded with severe soft tissue injuries depending on the stage of surgical treatment and the formation of "skin flaps".

2. Implementation of the developed models of rehabilitation of the the wounded servicemen with soft tissue defects into the practice of early rehabilitation will favor quality of medical care delivery to the servicemen; longer-term supervision of the wounded, especially at the stage of “skin flap” formation; this will prevent complications, including infectious and formation of contractures during prolonged rehabilitation period.

Conflict of interest. The authors declare no conflict of interest.

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