

## **MODULAR REHABILITATION SYSTEM AT THE STATIONARY PHASE OF REHABILITATION OF MILITARY MEN AFTER ACUTE NON-RHEUMATIC MYOCARDITIS**

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The paper presents the experience of rehabilitation treatment for servicemen who had suffered from acute non-rheumatic myocarditis. The treatment was conducted in the 1469 Naval Clinical Hospital of the Northern Fleet with using an 8-modular system of medical rehabilitation activities: a laboratory-diagnostic cluster with a patient's rehabilitation and expert evaluation and a rehabilitation prognosis; drug therapy, diet therapy, psychosomatic diagnosis and correction of the emotional state; therapeutic exercise with restoration of physical capability and adaptive health parameters; information cluster - providing the patient with a complete and accessible understanding of information about a healthy lifestyle; physiotherapeutic non-pharmacological correction of physiological disorders, activation of endogenous protective systems of the body; functional diagnostics complex: a study of restoration of functioning parameters for cardiovascular and respiratory systems, the development of the body's adaptation to physical exertion. As a result of using the modular system, a decrease in the average bed-day during the rehabilitation phase for patient after mild acute myocarditis was 16.6% (from  $17.5 \pm 1.3$  to  $14.6 \pm 2.7$  days); after moderate - 8.1% (from  $22.3 \pm 2$  to  $20.5 \pm 1.8$  days); and after severe - 5.9% (from  $27.2 \pm 3.5$  to  $25.6 \pm 1.2$  days). The rehabilitation program developed basing on principles of the theory of modules, is a dynamic, easily simulated system with a combination of variable and permanent elements, that allows to reduce the cost of treatment and rehabilitation in mild myocarditis by  $10.6 \pm 0.9\%$ , in moderate - by  $7.2 \pm 0.8\%$ , and in severe - by  $3.7 \pm 0.4\%$ .

**Key words:** marine medicine, medical rehabilitation, acute non-rheumatic myocarditis, clinical modular rehabilitation system.

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**Introduction.** Myocarditis, most fully described by N.R.Paleev, is a cardiac muscle damage, mainly, of inflammatory type due to a direct or indirect impact of infection, parasitogenic or parasitogenic invasion, chemical or physical factors as well as damage induced by allergic or autoimmune diseases via immune systems<sup>1</sup> [1, p. 9–10; 2, p. 32]. Absolute frequency of myocarditis is unknown, it is possible to look to the data of myocarditis incidence in different diseases. In diphtheria, myocarditis occurs in 20-30% of patients, in respiratory viral infections – in 1-5%, in other virus-associated diseases, incidence rate is up to 15%. Taking into account the overall incidence of ARVI in military, diagnosis and treatment of myocarditis in the Armed Forces of the Russian Federation is a topical issue<sup>2</sup> [3, p. 72–75; 4, p. 57].

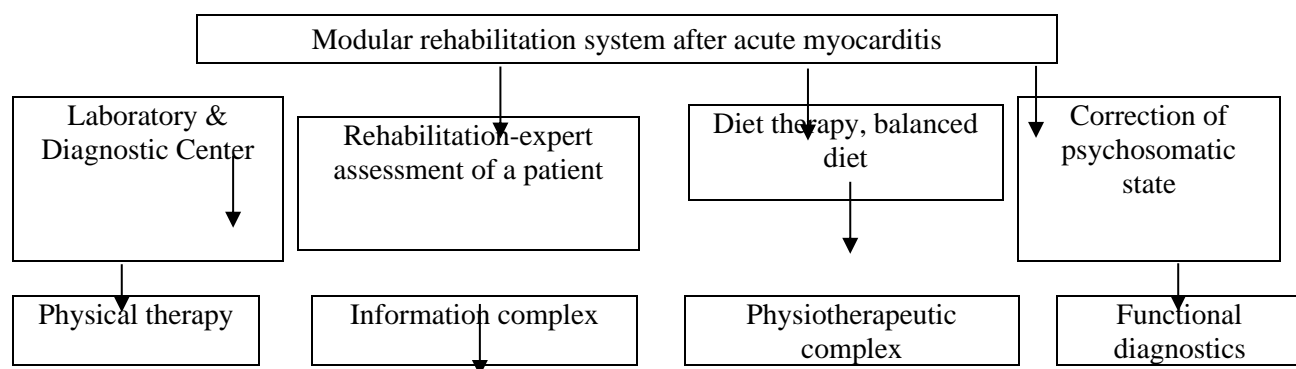
Steady state of treatment and rehabilitation is from 3 to 8 weeks and is defined by the severity of a past acute disease [5, p. 98]. It includes 3 steps: drug treatment, sanitation of focuses of persistent infection and early physical rehabilitation [6, p. 336–348].

In FSU “1469 Naval Clinical Hospital” of the Northern Fleet, medical rehabilitation measures in patients with non-rheumatic myocarditis are taken in accordance with Federal Law No. 323-FZ “On Public Health Protection in the Russian Federation” of November 21, 2011, Order of the Ministry of Health of the Russian Federation No. 1705n “On the Procedure for Organizing Medical Rehabilitation” of December 29, 2012, Peacetime Guidance on Medical Support of the Armed Forces of the Russian Federation which was approved by Order of the Deputy Minister of Defense of the Russian Federation No. 999dcp of November 25, 2016 and came into force from January 1, 2017, Medical Guidelines on “Medical Rehabilitation in the Armed Forces of the Russian Federation” approved by the Director of the Chief Military Medical

Directorate of the Ministry of Defense of the Russian Federation – Surgeon of the Armed Forces of the Russian Federation<sup>12</sup>.

**Results and discussion.** In order to create most favorable and optimum conditions for physical rehabilitation in the military after infectious-toxic myocarditis, especially on the background of significant adaptive overstress in young specialists, in FSI “1469 Naval Clinical Hospital” of the Ministry of Defense of the Russian Federation, the rehabilitation program technique based on a module theory was developed. The basic idea of the technique is that the rehabilitation program is a dynamic easily modelled system with a definite structure, specific combination of variable and constant elements, and executive staff: doctors, physical therapists, consultants of other specialties and experts-controllers.

The key advantage of the modular technique is a combinativity involving an ability to form different combinations of elements of rehabilitation process taking into account personality traits of a patient and his body response to therapy-rehabilitation measures held. Rehabilitation potential of the conscripted military is high due to the young age of the military, significant body compensation abilities, especially, in the mild course of myocarditis as an important criterion of selection of patients for a steady stage of the treatment. At initial assessment of patients, a rehabilitation prognosis (planned rehabilitation result) is determined: a) resynchronization of cardiovascular and respiratory systems; b) recovery of adaptive potential of circulatory system; c) formation of total adaptive potential; d) reduction of asthenodepressive syndrome; e) achievement of parameters of functional physiological state complying with the level of fitness for military service; f) formation of structural trail of adaptation to physical stress; g) formation of normal physiological response of cardiovascular system to physical stress; h) recovery (development) of the physical capability level (Figure 1).



**Figure 1.** The structure of the modular rehabilitation complex after acute non-rheumatic myocarditis

Program of examination, treatment and physical rehabilitation consists of 8 modules. The content of modules is given below.

**Module 1.** Name: special and laboratory research. Purpose: rehabilitation-expert evaluation of a patient. Executive staff: attending medical doctor, specialists of laboratory and functional diagnostics department, pulmonary, radiology and exercise therapy departments. The content of module 1 is presented and compiled by an attending doctor: unit 11 - laboratory research; unit 12 - radiology research; unit 13 – other research; unit 14 - specialists' examination including: psychotherapist, dietician, allergologist, dental surgeon, otolaryngologist, physical therapist and exercise physiologist.

**Module 2.** Name: diagnostic. Purpose: integral evaluation of patient state with rehabilitation diagnosis statement and planned rehabilitation result (rehabilitation prognosis). Executive staff: attending medical doctor. The content of module 2 is presented and compiled by an attending doctor: unit 21 - rehabilitation diagnosis; unit 22 – rehabilitation potential, unit 23 - rehabilitation prognosis (target rehabilitation programs); unit 24 – stage-by-stage control.

**Module 3.** Name: diet therapy. Purpose: supply of optimum protein-calorie nutrition in rational combination with biologically active additives, vitamins and adaptogens. Executive staff: dietician, dietary nurse. The content of module 3 is presented and compiled by a dietician: unit 31 - dietetic nutrition; unit 32 - biologically active additives; unit 33 - vitamin therapy; unit 34 – adaptogens.

**Module 4.** Name: psychotherapy. Purpose: revealing of psychosomatic disorders, evaluation of their manifestation, carrying out a psychotherapy for the disorders. Executive staff: psychotherapist, medical psychologist, attending doctor. The content of module 4 is presented by a psychotherapist, a medical psychologist: unit 41 – diagnostics of psychosomatic disorders: asthenic and asthenodepressive syndromes: disability for prolonged physical and mental stress, affective lability with predominantly subdued mood, irritability, somnopathy, depressing view of present and future life with the decrease in a motivation or amotivation for professional activities, psychological adaptation disorders; unit 42 - psychotherapeutic methods of correction: reintegration, recovering of the emotional state, shift in attitude toward psycho-traumatic situation causing a disease, a reconstruction of disturbed values and attitudes in concordance with existing possibilities, formation of an attitude to literal perception of social perspective; unit 43 – medicamentous correction of the sleep-wake schedule.

**Module 5.** Name: exercise therapy. Purpose: recovery of physical capability, adaptive health parameters. Executive staff: specialists of exercise therapy department, department charge nurse. The content of module 5 is presented by a doctor in exercise therapy and exercise therapy instructor: unit 51 - gymnastic exercises: morning hygienic gymnastics, gymnastics for prime and accessory respiratory muscles, gymnastics for an improvement of cerebral hemodynamics; unit 52 – conditioning; unit 53 - respiration exercises: expiratory resistive breathing in response to low-frequency oscillation, voluntary controlled breathing according to method No.1, voluntary controlled breathing according to method No.2, voluntary controlled breathing according to method No.3, voluntary controlled breathing according to method No.4.; unit 54 - physical conditioning exercises: cyclic interval aerobic submaximal physical exercise, dosed walking, elliptical training, step-up training, dosed walking; unit 55 – performance control: monitoring, milestone control, results control, calculation of adaptive potential; calculation of strength indices; calculation of a physical exercise tolerance; unit 56 - anthropomorphic measurements: extremity anthropometry, joint goniometry, static parameters of the spine, dynamic parameters of the spine.

**Module 6.** Name: informative. Purpose: the provision of information about healthy lifestyle, prevention and first aid for catarrhal diseases, traumas, bleeding, critical conditions. Executive staff: an attending doctor, head nurse of the relevant department, club and library personnel. The content of module 6 is presented by an attending doctor: unit 61 – healthy lifestyle lessons: self-monitoring of health parameters, formation of speed performance, physical endurance and reaction time, physical education – is the base of the health; unit 62 - first aid training: first aid for bleeding, fractures and dislocations, first aid for cardiac and respiratory arrest, first aid for road accidents, first aid for syncope.

**Module 7.** Name: physiotherapeutic. Purpose: drug-free correction of physiological disorders, activation of endogenic defensive body systems, creating the optimum background for recovery the physical capability. Executive staff: physiotherapeutic specialists: physiotherapist, reflexologist, physical therapy technician, massage therapy nurse. The content of module 7 is presented by physiotherapist: unit 71 - inhalation therapy, aerosol therapy, oxygen-barotherapy, aeroionotherapy, halo aerosol therapy, aromatherapy; unit 72 – interval normobaric hypoxic hypercapnic training; unit 73 – electrotherapeutics, electrosleep therapy, galvanization, transcerebral electrotherapy; unit 74 – magnetic wave therapy: low frequency magnetic therapy, impulse magnetic therapy, high frequency magnetic therapy; unit 75 - mechanical therapeutic factors: tonic massage, sedative massage, locomotor corrective massage, segmentary-reflex massage, vibrotherapy; unit 77 – reflexotherapy; unit 78 – phototherapy: chromotherapy, infrared irradiation, ultraviolet irradiation.

**Module 8.** Name: functional diagnostics. Purpose: the study of functional parameters of cardiovascular system, respiratory system, adaptation of patient organism to physical exercises. Executive staff: specialists of functional diagnostics department. The content of module 8 is presented by doctor in functional diagnostics: unit 81 – clinical electrocardiography: 12-lead ECG with 12-lead ECG recorder, drug challenge ECG, exercise ECG, ECG with additional leads, 24-hour Holter ECG monitoring; unit 82 – echocardiography; unit 83 – functional study of cardiovascular and respiratory systems: lung capacity (real and reference), oxygen consumption index, systolic and dynamic blood pressure (real and reference), 24-hour blood pressure monitoring, assessment of physical capability according to PWC 170, assessment of maximal oxygen consumption (MOC), physical assessment by 6-minute walking test, evaluation of physical capability level.

Average diagnostic values of disorders in acute myocarditis and time of recovery under treatment and rehabilitation are given in a Table.

**Average diagnostic values of disorders in acute myocarditis and time of recovery under treatment and rehabilitation**

Modular diagnostic values before recovery	Severity of past non-rheumatic acute myocarditis (n=64)		
	mild (n=48)	moderate (n=11)	severe (n=5)
HR, per minute	89.0±18.5	94.0±14.0	99.0±17.5
LVEF (by Teicholz), %	50.7±1.3	47.3±0.8	43.0±0.6
Systolic thickening of IVS/LVPW*, %	39.0±3.4/ 41.0±5.0	31.5±3.0/ 37.4±4.2	26.1±3.4/ 31.8±2.7
Arrhythmia, %	83.7±2.4	99.0±3.1	100.0
Average bed-day (treatment/rehabilitation)	25.3±1.9/ 14.6±2.7	35.6±3.5/ 20.5±1.8	43.4±4.0/ 25.6±1.2

\*IVS/LVPW — interventricular septum/ left ventricle posterior wall (normal: 40.0–70.0/40.0–70.0).

As a result of using the modular rehabilitation system at a stationary phase of rehabilitation, in period from 2014 to 2017 in the 1469 Naval Clinical Hospital of the Ministry of Defense in Severomorsk, 64 patients who had suffered from acute non-rheumatic myocarditis: in mild myocarditis – 48 (75.0%), in moderate myocarditis – 11 (17.2%), and in severe myocarditis – 5 (7.8%).

In a mild case of myocarditis, the HR was at average 89.0±18.5 per minute, LVEF was 50.7±1.3% by cardiac ultrasonography; systolic thickening of IVS was 39.0±3.4% and LVPW – 41.0±5.0%; cardiac rhythm disorders were observed in 83.7±2.4% of patients.

Module 1 (units 11-14), module 2 (units 21-23), module 3 (units 32, 33) module 4 (unit 42), module 5 (units 52-53 No.1, 2; 54-55), module 6 (unit 62), module 7 (units 71, 74,75,78), module 8 (units 81-82) were used during rehabilitation. An average bed-day was 25.3±1.9 during the treatment of acute stage of disease. With using given modules and blocks, an average bed-day of rehabilitation treatment for patients suffered from mild myocarditis with a recovery of all functional indices of cardiovascular, respiratory, musculoskeletal systems, laboratory parameters and special instrumental methods of diagnosis up to normal values was 14.6±2.7.

In non-rheumatic moderate myocarditis, the HR in patients was on average 94.0±14.0 per minute. By cardiac ultrasonography, LVEF (by Teicholz) was 47.3±0.8%; systolic thickening of IVS was 31.5±3.0% and LVPW – 37.4±4.2%; different cardiac rhythm disorders were diagnosed in 99.0±3.1% of patients. For rehabilitation after moderate myocarditis, module 1 (blocks 11–14), module 2 (blocks 21–24), module 3 (blocks 31–33), module 4 (block 42, 43), module 5 (blocks 51, 53 No.3; 54–56), module 6 (blocks 61, 62), module 7 (blocks 71–78), module 8 (blocks 81–83) were used. An average bed-day was 35.6±3.5 during the treatment. With using developed modular systems and individual blocks for rehabilitation after moderate myocarditis, a duration of rehabilitation treatment with a recovery of all functional indices of cardiovascular, respiratory, musculoskeletal systems, laboratory parameters and special instrumental methods of diagnosis up to normal values was 20.1±1.8 days.

Severe myocarditis was associated with HR acceleration up to 99.0±17.5 per minute, reduction of LVEF to 43.0±0.6%; decreasing of systolic thickening of IVS to 26.1±3.4% and LVPW – 31.8±2.7%; different cardiac rhythm disorders were diagnosed in 100% of patients. An average bed-day for severe myocarditis treatment was 43.4±4.0. The optimum modules for rehabilitation were module 1 (blocks 11–14), module 2 (blocks 21–24), модуль 3 (blocks 31–34), module 4 (blocks 41–43), module 5 (blocks 51, 53 No.4; 54–57), module 6 (blocks 61, 62), module 7 (blocks 71–78), module 8 (blocks 81–83). As a result of using the developed modular system for severe myocarditis, a recovery of all functional indices of cardiovascular, respiratory, musculoskeletal systems, laboratory parameters and special instrumental methods of diagnosis up to normal values was marked within 25.6±1.2 days.

## Conclusions:

1. Stationary phase of medical rehabilitation of patients after acute non-rheumatic myocarditis is functionally and cost-effective multicomponent staged system of functional recovery of cardiovascular system.
2. As a result of using the modular system, decreasing of an average bed-day during a rehabilitation treatment phase after acute mild myocarditis was 16.6% (from  $17.5 \pm 1.3$  to  $14.6 \pm 2.7$  days); after moderate – 8.1% (from  $22.3 \pm 2.0$  to  $20.5 \pm 1.8$  days); after severe – 5.9% (from  $27.2 \pm 3.5$  to  $25.6 \pm 1.2$  days).
3. The rehabilitation program developed basing on principles of the theory of modules, is a dynamic, easily simulated system with a combination of variable and permanent elements, that allows to reduce the cost of treatment and rehabilitation in mild myocarditis by  $10.6 \pm 0.9\%$ , in moderate - by  $7.2 \pm 0.8\%$ , and in severe - by  $3.7 \pm 0.4\%$ .
4. In forming the program of examination, treatment and stationary phase of medical rehabilitation in a district (naval) clinical hospital, it is essential to use the whole potential of diagnostic and treatment departments, exercise therapy and physiotherapy.

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