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## Complex treatment of patients with vertebral thoracalgia using manual therapy and physical rehabilitation

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A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation; D – writing the article; E – critical revision of the article; F – final approval of the article

**The aim** is to increase the effectiveness of complex treatment for patients with vertebral thoracalgia (VT) and muscular-tonic signs using manual therapy and physical rehabilitation in the form of active and passive kinesiotherapy.

**Materials and methods.** A complex vertebro-neurological examination and treatment of 237 patients with VT with muscular-tonic signs was done. The main group included 165 men (69.6 %), and 72 patients (30.4 %) were in the comparison group. All patients were given a complex therapy in a specialized vertebro-neurological department including drug treatment (according to indications) as well as physical and balneological treatment, acupuncture, mud treatment, hardware underwater stretching of the thoracic spine, various types of massage, etc. Manual therapy (MT) and physical rehabilitation in the form of active and passive kinesiotherapy were included in the complex of therapeutic measures among the patients of the main group.

**Results.** In patients with VT of the main group, 149 patients (90.4 %) with significant improvement were discharged, and in the comparison group – 45 (62.5 %) patients. Improvement was observed among 9 (5.4 %) patients with VT of the main group, and in 13 patients (18.1 %) of the comparison group. A slight improvement was in 7 (4.2 %) and 9 (12.5 %) patients, respectively. In the main group of patients with VT, there were no individuals without improvement, while in the comparison group there was no improvement in 5 (6.9 %) patients. The average treatment duration of patients in the main group was  $13.6 \pm 1.5$  days, and in the comparison group it was  $18.1 \pm 1.6$  ( $P < 0.05$ ).

**Conclusions.** Rehabilitation treatment of patients with VT with muscular-tonic signs should be complex and gradual with the differential use of various methods and ways of rehabilitation therapy. Integrating manual therapy and physical rehabilitation in the form of active and passive kinesiotherapy in the complex rehabilitation for VT patients with muscular-tonic signs contributes to the effectiveness of treatment and more rapid recovery of patients.

### Key words:

vertebral thoracalgia, manual therapy, physical and rehabilitation medicine.

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### Комплексне лікування хворих на вертебральні торакалгії з застосуванням мануальної терапії та фізичної реабілітації

O. A. Козьолкін, С. О. Медведкова, І. М. Ляхова, С. М. Малахова, О. О. Лісова, О. О. Черепок

**Мета роботи** – підвищити ефективність комплексного лікування хворих на вертебральні торакалгії (ВТ) з м'язово-тонічними проявами шляхом застосування мануальної терапії та фізичної реабілітації у вигляді активної та пасивної кінезотерапії.

**Матеріали та методи.** Виконали комплексне вертебро-неврологічне обстеження та лікування 237 осіб, які хворі на ВТ із м'язово-тонічними проявами. З них 165 осіб (69,6 %) становили основну групу, а 72 пацієнти (30,4 %) увійшли у групу зіставлення. Всім хворим здійснили комплексну терапію у спеціалізованому вертебро-неврологічному відділенні з включенням медикаментозного (за показаннями) та фізіобальнеологічного лікування, голкорексфлексотерапії, грязелікування, апаратного підводного витягування грудного відділу хребта, різні види масажу тощо. Хворим основної групи в комплекс лікувальних заходів включали мануальну терапію (МТ), фізичну реабілітацію у вигляді активної та пасивної кінезотерапії.

**Результати.** У хворих на ВТ основної групи з суттєвим поліпшенням виписали 149 хворих (90,4 %), а у групі зіставлення – 45 (62,5 %) пацієнтів. Поліпшення спостерігали в 9 (5,4 %) хворих на ВТ основної групи та у 13 (18,1 %) групи зіставлення. Незначне поліпшення було у 7 (4,2 %) і 9 (12,5 %) хворих відповідно. В основній групі осіб, які хворі на ВТ, не було пацієнтів без поліпшення, а у групі зіставлення поліпшення не спостерігали у 5 (6,9 %) хворих. Середні терміни лікування хворих в основній групі становили  $13,6 \pm 1,5$  доби, а у групі зіставлення –  $18,1 \pm 1,6$  ( $p < 0,05$ ).

**Висновки.** Реабілітаційне лікування хворих на ВТ із м'язово-тонічними проявами повинно бути комплексним, етапним із диференційованим використанням різних методів і способів відновної терапії. Включення в комплексну реабілітацію хворих на ВТ із м'язово-тонічними проявами мануальної терапії та фізичної реабілітації у вигляді активної та пасивної кінезотерапії сприяє підвищенню ефективності лікування та швидшому відновленню пацієнтів.

### Ключові слова:

вертебральна торакалгія, мануальна терапія, фізикальна та реабілітаційна медицина.

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### Комплексное лечение больных вертебральными торакалгиями с применением мануальной терапии и физической реабилитации

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**Цель работы** – повысить эффективность комплексного лечения больных вертебральными торакалгиями (ВТ) с мышечно-тоническими проявлениями путем применения мануальной терапии и физической реабилитации в виде активной и пассивной кинезотерапии.

### Ключевые слова:

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**Материалы и методы.** Проведено комплексное вертебро-неврологическое обследование и лечение 237 больных ВТ с мышечно-тоническими проявлениями. Из них 165 человек (69,6 %) составили основную группу, а 72 пациента (30,4 %) вошли в группу сравнения. Всем больным проведена комплексная терапия в специализированном вертебро-неврологическом отделении с включением медикаментозного (по показаниям) и физиобальнеологического лечения, иглорефлексотерапии, грязелечения, аппаратного подводного вытяжения грудного отдела позвоночника, различные виды массажа и т.д. Больным основной группы в комплекс лечебных мероприятий включена мануальная терапия (МТ) и физическая реабилитация в виде активной и пассивной кинезотерапии.

**Результаты.** У больных ВТ основной группы со значительным улучшением выписаны 149 больных (90,4 %), а в группе сравнения – 45 (62,5 %) пациентов. Улучшение наблюдалось у 9 (5,4 %) больных ВТ основной группы и у 13 (18,1 %) группы сопоставления. Незначительное улучшение было, соответственно, у 7 (4,2 %) и 9 (12,5 %) больных. В основной группе больных ВТ не было пациентов без улучшения, в то время как в группе сравнения улучшения не отмечены у 5 (6,9 %) больных. Средние сроки лечения больных в основной группе составили  $13,6 \pm 1,5$  дня, а в группе сравнения –  $18,1 \pm 1,6$  ( $p < 0,05$ ).

**Выводы.** Реабилитационное лечение больных ВТ с мышечно-тоническими проявлениями должно быть комплексным, этапным с дифференцированным использованием различных методов и способов восстановительной терапии. Включение в комплексную реабилитацию больных ВТ с мышечно-тоническими проявлениями мануальной терапии и физической реабилитации в виде активной и пассивной кинезотерапии способствует повышению эффективности лечения и более быстрому восстановлению пациентов.

## Introduction

Vertebrogenic diseases of the peripheral nervous system are of great concern in clinical medicine [2,3,9]. These diseases mostly affect people of working age, have a chronic relapsing course and lead to a long-term disability, and sometimes to disability of patients [4,5,6,7]. This problem has not only medical, but also a great socio-economic importance [10,11]. That is why, the development of effective treatment, rehabilitation and preventive measures aimed at reducing vertebrogenic diseases of the peripheral nervous system, is one of the main tasks of modern neurology [4,9,14,15].

In this regard, in recent years there have been quite a lot of works devoted to the gradual rehabilitation treatment for patients with neurological signs of degenerative-dystrophic pathology (DDP) of the spine [4,10,12,13]. However, most of them were dedicated to the treatment of patients with lumbar osteochondrosis.

The literature analysis and results of scientific researches showed that, up to now, many issues of care for patients with vertebral thoracalgia have been studied not enough, and the proposed medical complexes have a line of disadvantages:

1. Clinical features of VT are not included in the complex therapeutic measures.
2. Drug therapy prevails at all stages of complex treatment regardless the pain syndrome severity.
3. The items of choice as for different methods and their combination in medical complexes have not been studied enough.
4. Therapeutic measures are standardized without taking into account the specific syndrome, the stage of the disease and clinical signs severity.
5. There are no clear criteria for differential use of manual therapy (MT) and other types of kinesiotherapy in therapeutic complexes for patients with VT.
6. Therapeutic measures are practically not combined with rehabilitation and preventive ones.
7. There is no clear continuity, consistency and stage-by-stage approach to complex treatment.

All this has necessitated further development and organization of a specialized care system for a large number of patients with neurological signs of spinal DDP

and the creation of more effective, pathogenetically substantiated medical complexes with predominant use of non-pharmacological treatment methods.

## The aim

The aim of our study was to increase the effectiveness of complex treatment for patients with VT and muscular-tonic signs using manual therapy and physical rehabilitation in the form of active and passive kinesiotherapy.

## Materials and methods

In total, 237 patients with vertebral thoracalgia and muscular-tonic signs were under our supervision; 165 of them (69.6 %) were included in the main group, and 72 patients (30.4 %) comprised the comparison group. In this study, we used the classification of peripheral nervous system diseases [1]. All patients underwent spinal computed tomography to confirm the clinical diagnosis and they were given a complex rehabilitation therapy including medical, physio-balneological treatment, acupuncture, mud therapy, spinal traction, massage, exercise therapy, etc. In the main group, MT and physical rehabilitation in the form of active and passive kinesiotherapy were used additionally.

There were 60 men (36.3 %) and 105 women (63.7 %) in the main group of patients with VT. The majority of individuals were younger than 40 years – 108 people (65.5 %) engaged in intellectual work, 121 (73.3 %) light-intensity physical workers, 115 patients (69.7 %) working in conditions of prolonged static postures and performing repetitive movements. The disease duration was less than 5 years in 110 patients (66.7 %).

All patients of both groups were treated in a specialized vertebral neurological department.

A peculiarity of the complex treatment for patients with VT and muscular-tonic signs of the main group was the use of MT and physical rehabilitation in the form of active and passive kinesiotherapy.

A necessary condition for MT use was the presence of vertebral motor segment (VMS) or other thoracic joints functional blocking. MT was conducted according to strict indications on a blocked segment only if there were at least three free directions of movement in VMS.

The reception formulation of MT techniques was selected for each patient individually, depending on the specific neurological syndrome, pain severity as well as the level, degree and direction of VMS functional blocking.

The scheme of MT application was as follows: daily massages and mobilizations as well as a manipulation at the blocked segment level and not more than once every 5–7 days.

Patients of the main group received MT in full form (massage, mobilization and manipulation). For all patients of this group, in addition to MT techniques, post-isometric muscle relaxation (PIMR) was used combined with respiratory-oculomotor synergies, as well as kinesiotherapy (auto-mobilization).

Mobilization techniques of MT were carried out within the limits of physiological mobility and in free directions in a rhythmic mode 5–7 times in one direction. The peculiarity of the mobilization use on the chest level was its obligatory combination with the patient's respiratory wave: during expiration – mobilization, during inspiration – pause.

We have proposed a method of complex mobilization effect for patients with VT and shoulder-scapular periarthrosis syndrome (SSP). In VT syndrome with SSP, a number of functional blocks is a common occurrence: segment CII-DI, the first rib, shoulder joint, scapular. To achieve a therapeutic effect, it is necessary to influence both on vertebral and extravertebral foci of pathological impulses. For this purpose, we used mobilization techniques in the following sequence: mobilization of the segment CII-DI in a rhythmic mode 5–7 times, in the absence of effect, manipulation can be repeated; mobilization of the first rib in combination with the respiratory wave – 7–10 times; scapula mobilization on the side of pathology – 5–7 times; mobilization with PIMR of the blocked shoulder joint 7–10 times, in order to achieve deblocking, it is possible to carry out a manipulation. All methods were used every day.

In patients with VT and muscular-tonic signs with significant hypertonus, mobilization and postisometric muscle relaxation (PIMR) were applied. The advantage of PIMR is the possibility of targeted relaxing effect practically on any group of muscles.

PIMR included two phases: 1) isometric muscle tension – when the patient tried to overcome a moderate resistance to movement in the opposite direction to functional blocking or movement as for dynamic work of the corresponding muscle. The reduction was carried out during expiration for 10 seconds, followed by a breath hold for 3–5 seconds. In order to potentiate the effect, simultaneously with the isometric contraction, the patient performed eye movement in the opposite to functional blocking direction; 2) postisometric relaxation of the patient's muscles and their passive, moderate stretching in the direction of the functional block or along the longitudinal axis of the muscle. The second phase was carried out during expiration for 10–20 seconds; eye movement was performed simultaneously with the muscle stretching in the direction of the function block.

In the complex of manual therapy in the main group of patients, we preferred mobilization techniques as we considered them more physiological and less traumatic. Only in cases when deblocking of VMS was not achieved after a prolonged use of mobilization and the severity of pain

was no higher than II degree (according to I. P. Antonov), we resorted to manipulations.

The method of thermal relaxation was performed in a specially equipped sauna, consisting of a thermo-relaxation chamber with a sliding table and a room for MT.

The advantages of segmental thermal relaxation were: the possibility of a graduated therapeutic modality for the musculoskeletal system; limiting patient's body exposure to heat; reducing the risk of occurrence some unwanted complications. The temperature in the chamber was 90–100 °C, exposure time was 5–10 min. Under the influence of dry heat, the muscles relaxed and when the patient left the thermo-relaxation chamber, manipulation was immediately performed on the table at the level of the blocked thoracic VMS. The use of thermal relaxation allowed reducing the time spent on preparatory techniques (massage, mobilization) for further manipulative release of VMS. Thermal relaxation was applied twice a week.

Methods of MT were used differentially depending on the pain syndrome severity (the manipulative effect was limited in III degree pain syndrome). In case of muscular-tonic signs of VT, preference was given to muscle mobilization and PIMR methods.

Active and passive kinesiotherapy (methods of auto-mobilization and auto-PIMR) were widely used in patients of the main group.

We have proposed a technique of passive, postural auto-mobilization in order to relax the back muscles in VT patients with hyperkyphosis of the thoracic spine. The patient was lying on his back on a spherical table for 20 minutes. Gradually, the thoracic spine got an extensor position, relaxation of the long back muscles occurred and pain decreased. This method of back muscles unloading can also be used for prophylactic purpose, especially for patients whose work is related to prolonged postural exercises.

An important component of the complex treatment for patients with VT and muscular-tonic signs was spinal traction, influencing a number of pathogenetic links underlying the neurological signs of spinal DDP. Traction increases the diameter of the intervertebral space, thereby reducing the nerve root compression, and also contributes to pain impulse reduction due to decrease in muscle tone.

During VT patients treatment, we used two types of tractions: hardware ("dry") and underwater. A course consisted of 10 tractions. However, when choosing the type of tractions for patients with VT and muscular-tonic signs, preference was given to underwater tractions, because muscle relaxation in warm water (t 27–30 °C) was faster, the pain was reduced allowing them to move easily.

140 (84.8 %) patients of the main group received underwater traction, additional weights were applied to 78 (47.2 %) of them according to the method developed by us, and traction with patient's own weight was used in 62 (37.6 %) persons. Hardware traction of the thoracic spine was used in 25 patients (15.2 %). In patients with significant hypertonus, underwater traction was combined with hydromassage.

In the complex treatment of patients with VT, physiotherapeutic methods were also used: ultrasound, magnetic laser therapy, constant magnetic field, diadynamic currents, sinusoidal modulated currents, medicines iontophoresis, dermal electrical stimulation for relieving pain, acupuncture, vacuum massage, mud therapy, balneotherapy.

Among physiotherapeutic methods, sinusoidal modulated, diadynamic currents and magnetic laser therapy were used more often.

We have proposed a method of magnetic-laser therapy combined with muscle mobilization in VT patients with muscular-tonic signs. Firstly, laser radiation with a pulse frequency rate of 1500 Hz was used, the power maximum intensity CMF-20–50 MTI, the exposure time was 10 minutes including paravertebral tender points for 256 seconds and muscle pain zones for 6 minutes – a labile technique. Then the methods of muscle mobilization were used in free from blocking directions, 5–7 times in one direction combined with the respiratory wave in a rhythmic mode. 76 patients (46.1 %) had good treatment responses.

Balneotherapy was used among 156 patients of the main group (94.5 %), mainly radon, naphthalan and turpentine baths.

Mud therapy in the form of mud applications and galvanic mud was used for 16.2 % of patients.

Ozokerite therapy was applied to 50 patients (30.3 %) with muscular-tonic signs to the zones of tense muscles.

Manual and electrical acupuncture was performed among 67 patients (40.6 %). Depending on the muscle state, reinforcing and reducing techniques were used. Acupoints were mainly used to reduce muscle hypertonus and pain.

All patients of the main group performed a program of individual exercises using auto-mobilization techniques and auto-PIMR every day.

As for drug therapy, it was used extremely rarely and in limited manner for patients of the main group: short courses of nonsteroidal anti-inflammatory drugs prescription for 3–5 days, therapeutic blockades and iontophoresis.

All patients of the main group presented a therapeutic benefit after the following order of therapeutic measures: thermal muscle relaxation – massage (segmental, linear) – MT (in full volume, including manipulations) – tractions (“dry” or underwater) – rest for 2 hours – physioalneo procedures – auto-mobilization, auto-PIMR.

The effectiveness of the complex treatment of patients with VT was assessed in dynamics according to a number of subjective and objective criteria. Subjective signs were based on patients' complaints and their dynamics in the treatment course. More informative objective criteria were identified by neurological and manual examination. The results of the study were processed using the program Statistica 13.0 (StatSoft Inc., USA, serial number JPZ804138230ARCN10-J). A significance of differences between indicators was determined by the Student's method.

The treatment results among VT patients with muscular-tonic signs were different, so we identified several options for outcomes. Significant improvement was characterized by complete elimination of all vertebral neurological signs of the thoracic spine DDP: pain relief, release of VMS and additional joints (rib-vertebral, rib-chest), full vertebrodynamics recovery, normalization of manual and muscle testing (MMT) indices (muscle tone, vibration recoil coefficient), reduction of myofascial loci in affected muscles. Such patients were considered practically healthy and discharged to work without any restrictions. Improvement was the result of treatment if the pain syndrome was reduced to mild (I degree), movement in the spine became satisfactory

with a little restriction, muscle tone normalized to 1st degree, the value of vibration recoil coefficient of clinically significant myofascial structures did not exceed three units. Patients of this group were also considered able-bodied and were discharged to work, but with recommendations to limit physical exertion and other provoking factors. A slight improvement was determined with a slight pain reduction, blocking VMS, other thoracic joints, quite notable movement restriction in the thoracic spine and a slight positive dynamics in muscle tone and CVR. Patients of this group remained disabled and, as a rule, underwent courses of complex treatment for the second time. A result without improvement was considered if patients did not show positive dynamics in vertebral neurological signs following the therapy. Their further management was the same as with a slight improvement.

## Results

In both groups, patients slightly differed as for the pain degree, vertebrodynamics violation, degenerative-dystrophic process stage of spine DDP, as well as for the disease and exacerbation duration.

The onset of the disease was gradual in the majority of patients in the main group – 151 (91.5 %) and its duration was chronic relapsing in 103 patients (62.4 %) and chronic one – in 45 (27.3 %) patients. Duration of exacerbation among the majority was up to 1 month – 94 patients (56.9 %). The provoking factors for disease were physical overstrain and hypothermia in 134 patients (81.2 %).

The main complaint of VT patients with muscular-tonic signs was dull and compressive pain often accompanied by a feeling of “tightening” in the affected muscles.

During manual muscle testing (MMT), diffuse muscle painfulness was determined without clearly defined boundaries in some muscle regions. Only in 6 patients (3.6 %), a local muscle tone of the rib portion of the pectoralis major muscle in the middle muscular fascicle was increased by palpation, which was regarded as a consequence of early gradual transformation of the muscular-tonic process into a neurodystrophic one. In this group of patients, the average increase in muscle tone was  $2.25 \pm 0.48$ , the vibration recoil coefficient –  $4.5 \pm 1.2$  before the treatment [3,9].

Changes in the spine configuration were determined in 115 patients (69.7 %), in most cases, thoracic hyperkyphosis and muscle scoliotic spinal deformities were revealed in 78 patients (47.3 %) and 28 patients (16.9 %), respectively.

Movement restrictions due to VMS functional blocking were observed in all patients with varying degree of severity. The distribution of VMS blocking by levels was as follows: cervicothoracic junction (CVII–ThII) – in 63 patients (38.2 %), middle thoracic spine (ThIII–ThVII) – in 134 patients (81.2 %), lower thoracic and upper lumbar spine (ThVIII–LII) – in 33 patients (20.0 %). It should be noticed that 68 patients (41.2 %) had combined blocking at different levels.

The blocking of other thoracic joints in VT patients with muscular-tonic signs was revealed in 128 people (77.5 %). From this number, the costal-vertebral joints blocking was determined in 65 patients (39.4 %), costal-sternum joints – in 16 (9.7 %), scapulae and ribs in 24 patients (14.5 %) and combined blocking of several other thoracic joints was observed in 23 patients (13.9 %).

**Table 1.** Comparative data of the treatment results in VT patients of the main and comparison group

Clinical groups	Number of observations	Results of the treatment				Average treatment duration (days)
		significant improvement	improvement	slight improvement	without improvement	
Main group	165	149 (90.4 %)	9 (5.4 %)	7 (4.2 %)	–	13.6 ± 1.5
Comparison group	72	45 (62.5 %)	13 (18.1 %)	9 (12.5 %)	5 (6.9 %)	18.1 ± 1.6

Sensibility disorders were determined only in 16 patients (9.7 %), mostly by projection, in the greatest muscle pain areas of affected region.

The comparison group consisted of 72 VT patients with muscular-tonic signs who did not received MT treatment and kinesiotherapy in the complex rehabilitation. The selection of patients in the comparison group was carried out according to the same criteria as in the main group. Of those, 25 (34.7 %) were male and 47 (65.3 %) female. Adults from 36 to 65 years old prevailed – 58 people. The duration of the disease was different: less than two years – in 20 patients, from 2 to 5 years – in 19 patients and over 5 years – in 33 patients.

Analysis of working conditions showed that in the comparison group, as well as in the main group, people engaged in intellectual work prevailed – 49 people (68.0 %) and working conditions were associated with heavy physical exertion only in 23 patients (31.9 %). The specificity of working conditions in the majority of patients consisted of prolonged statistic loads on the thoracic spine and the thorax due to repetitive movements in the same postures – in 52 patients (72.2 %).

Among the provoking factors, physical overstrain was detected more often – in 39 patients (54.2 %) and hypothermia – in 23 (31.9 %) patients. 3 patients (4.2 %) had a sudden movement as a trigger, and another 3 (4.2 %) had stress. In total, 4 patients (5.5 %) had exacerbations for no apparent reason.

All patients were at the stable stage of exacerbation with chronic relapsing VT course and muscular-tonic signs.

According to clinical signs, the main group and the comparison group of patients did not differ significantly. The average magnitude of hypertonus in this group was  $2.18 \pm 0.73$ , and CVR –  $4.37 \pm 1.08$ , in the main group –  $2.25 \pm 0.48$  and  $4.5 \pm 1.2$ , respectively [3,9].

Cure response was determined by the positive dynamics of clinical VT symptoms, among which the pain syndrome severity figured prominently.

Complete pain relief was revealed in 129 (78.2 %) patients of the main group; pain reduction to a mild degree (which was clearly noticed during physical exertion on the thoracic spine and chest as well as during sudden movements) was found in 36 patients (21.8 %). 46 (63.7 %) of patients presented a complete pain relief, in 24 (33.3 %) patients the pain was reduced and the pain syndrome did not change significantly and remained at a moderate level in 2 patients (2.8 %), while these indicators were worse in the comparison group.

In addition to the pain syndrome severity, the important clinical criteria for improvement in condition of patients were the severity of muscle hypertonia in affected muscle areas. Among 165 patients in the main group, 131 people (79.4 %) had their muscle tone normalized, and in the comparison group – 46 patients (63.8 %). The average muscle tone in patients of the main group was  $0.2 \pm 0.1$ , while before

the treatment it was  $2.2 \pm 0.5$  ( $P < 0.05$ ). In the comparison group, these indicators were  $1.3 \pm 0.2$  and  $2.5 \pm 0.3$ , respectively.

In addition, positive changes were noticed in the parameters of zones with maximum palpatory soreness in the chest areas obtained by MMT. After treatment, 153 people (92.7 %) of the main group with thoracalgia and muscular-tonic signs showed neither muscle pain nor pain in bone-articular structures by MMT, and only 12 patients (7.3 %) presented mild, diffuse, without clearly defined boundaries palpatory soreness within some chest areas. In the comparison group these indexes were in 58 (80.5 %) and in 14 (19.5 %) patients, respectively.

The dynamics of the average CVR in patients of the main group was as follows: before treatment, this indicator was  $4.5 \pm 1.1$ , after treatment –  $0.6 \pm 0.2$  ( $P < 0.05$ ), in the comparison group these indicators were  $4.37 \pm 1.08$  and  $1.2 \pm 0.3$ , respectively.

An important indicator in the analysis of the treatment results was the degree of the thoracic spine vertebrodynamics recovery in VT patients. In the main group, vertebrodynamics was completely recovered in 95.8 % of patients and it was improved in 4.2 %. In the comparison group, a complete recovery of vertebrodynamics was noticed in 80.6 %, improvement – in 12.5 %, without any changes – in 6.9 %.

Symptoms of tension, determined in all VT patients of both groups before treatment, also were changed. So, after treatment, in the main group, these symptoms were not revealed in 152 patients (92.1 %) and reduced in 13 patients (7.9 %). In the comparison group, in 56 patients (77.8 %) and in 14 patients (19.4 %), respectively, at the same time, 2 patients (2.8 %) had tension symptoms unchanged.

Functional blocking of affected VMS diagnosed in all patients before treatment was determined only in 7 patients (4.2 %) of the main group and in 16 patients (22.2 %) of the comparison group on examination after treatment. Other thoracic joints blocking (costal-vertebral and costal-sternal) was revealed in 8 patients (4.8%) of the main group and in 17 patients (23.6 %) of the comparison group after treatment.

To assess the effectiveness of the complex treatment with MT use, we conducted a comparative analysis of the treatment results among VT patients of the main and comparison group (Table 1).

As can be seen from the data presented in Table 1, the average duration of treatment was  $13.6 \pm 1.5$  days for patients of the main group, and 149 patients (90.4 %) were discharged with a significant improvement, 9 (5.4 %) patients with improvement. Thus, working capacity was recovered in 158 people (95.8 %).

The treatment results of patients were significantly worse in the comparison group than patient outcomes using MT. The average duration of treatment in the comparison group was  $18.1 \pm 1.6$  days, and in the main group  $13.6 \pm 1.5$  ( $P < 0.05$ ).



45 patients (62.5 %) of the comparison group and 149 patients (90.4 %) of the main group were discharged with a significant improvement, with an improvement – 13 (18.1 %) and 9 people (5.4 %), respectively, with a slight improvement – (12.5 %) and 7 (4.2 %), respectively; without improvement – 5 patients (6.9 %) of the comparison group. All these indicators of treatment effectiveness were statistically significant ( $P < 0.05$ ).

### Discussion

Our complex examination and treatment for VT patients with muscular-tonic signs allowed us to identify their vertebral neurological features and apply pathogenetically substantiated methods of therapy. The complex of therapeutic measures followed the principles of individual approach to a patient taking into account the pain syndrome severity, degree of vertebrodynamics violation and somatic status. The sequence of the applied methods of treatment was accompanied by a differential assessment of their effectiveness.

We achieved positive results in both groups. 95.8 % of patients in the main group and 80.6 % of the comparison group were discharged with significant improvement and improvement after treatment. All these patients recovered the capacity for work. This indicates a high efficiency of the complex treatment. The obtained data are consistent with the works of many authors proving the positive effect of complex therapy in patients with vertebrogenic diseases of the peripheral nervous system [4,8,9,14,15].

At the same time, the treatment results obtained by us in the main and the comparison group differed significantly. In the main group, 90.4 % of patients were discharged with a significant improvement, while in the comparison group only 62.5 % ( $P < 0.05$ ). The average duration of treatment in the main group was  $13.6 \pm 1.5$  days, versus  $18.1 \pm 1.6$  ( $P < 0.05$ ). The difference between indicators was statistically significant and suggested a higher efficacy of complex therapy using MT and physical rehabilitation in the form of auto-mobilization and auto PIMR.

Manual therapy as a treatment for vertebral syndromes has been described by many authors. At the same time, MT in the form of monotherapy is inferior to complex treatment with the use of MT and physical rehabilitation [10,11,13].

The results of our work are consistent with the data of other researchers, which proved the positive impact of the integrated treatment for vertebral syndromes using MT and physical rehabilitation [2,4,10,11].

Thus, a comparative analysis of the treatment results in VT patients with muscular-tonic signs showed that the differential use of MT techniques and physical rehabilitation in a complex of therapeutic and rehabilitation measures contributed to a significant increase in the effectiveness of therapy and shortening the duration of treatment for patients.

### Conclusions

1. Clinical and pathobiokinematic peculiarities of VT with muscular-tonic signs identified in a detailed vertebral neurological study with the definition of functional blocking of VMS and muscle imbalance should be considered when using MT.

2. Rehabilitation treatment for VT patients with muscular-tonic signs should be complex and gradual with the differential use of various methods and techniques of rehabilitation therapy.

3. Integrating manual therapy and physical rehabilitation in the form of active and passive kinesiotherapy in the complex rehabilitation for VT patients with muscular-tonic signs contributes to the effectiveness of treatment and more rapid recovery of patients.

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