

Approaches to the stage-by-stage and complex treatment of children with dysplastic scoliosis of i - ii degrees

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Abstract

The problem of treating dysplastic scoliosis in children is very relevant. The significant prevalence of pathology and early disability of patients necessitates the development of new methods to increase the effectiveness of therapeutic approaches, especially at the initial stages of the pathological process. Important for treatment is the consideration of dysplastic scoliosis as a manifestation of mesenchymal insufficiency syndrome. Our study aimed was to create individual stage-by-stage rehabilitation programs for children with dysplastic scoliosis of the I-II degree, including methods of differentiated kinesiotherapy and electrotherapy. In our study, we analyzed the results of complex stage-by-stage approaches to the treatment of children from 7 to 16 years old with dysplastic scoliosis of the I-II degree. Treatment and rehabilitation complexes included climatotherapy, standard kinesiotherapy, electrotherapy, massage, and balneotherapy (sanatorium-resort stage), as well as combined kinesiotherapy at the outpatient stage. The use of staged and integrated approaches to the treatment of children with dysplastic scoliosis of the I-II degree increases the effectiveness of therapy. It improves the quality of life of this group of patients.

Key words: *scoliosis, children, treatment, electrotherapy, kinesiotherapy, connective tissue dysplasia,*

Introduction

Dysplastic scoliosis (DS) occupies a leading place in the structure of pediatric orthopedic pathology. The problem of diagnosis and treatment of DS in children is one of the critical problems in pediatrics and orthopedics, not only due to the significant prevalence of pathology but also because of the frequent complications with the development of severe deformities. The progressive nature of the course of the disease leads to the development of a scoliotic disease, early disability in 50 - 75% of cases (1, 2).

Connective tissue dysplasia (CTD) is a genetically determined condition characterized by defects in the fibrous structures and the primary substance of the connective tissue. They lead to disruption in the formation of organs and systems, have a progressive course, and determine the characteristics of the associated pathology. Undifferentiated CTD is a heterogeneous group of diseases, which, in turn, can lead to various chronic diseases with impaired morphology and function of internal organs (3, 4).

A variety of clinical manifestations characterizes CTD: from benign subclinical forms to multiple organ and polysystemic pathologies, often with a progressive course. CTD in children, being a multifactorial pathology, phenotypically manifests itself as numerous organ disorders, primarily from the cardiovascular and nervous systems, as well as the musculoskeletal system (5, 6).

Clinical and morphological manifestations of undifferentiated CTD may include various skeletal changes associated with a violation of the cartilage structure: disproportionately long limbs, arachnodactyly, chest deformities, spinal deformities, flat feet, pathology of tooth development, occlusion, joint pathology (7). Changes in the skin are also characteristic: hyperelasticity, thinning, a tendency to trauma, and the like. Also, CTD manifests various lesions of the cardiovascular system: prolapse of the heart valves, venous insufficiency, varicose disease, etc. Also, with a high frequency, there are changes in the

organs of the gastrointestinal tract, genitourinary, and bronchopulmonary systems (3, 5, 6).

DS, as a rule, is one of the manifestations of the connective tissue dysplasia syndrome, which, of course, requires consideration when compiling individual comprehensive programs for the rehabilitation treatment of this patient population.

The basic complex of treatment for children with DS consists of massage, physiotherapy, apparatus physiotherapy, and the like.

Physiotherapeutic methods are an essential component of integrated approaches in the treatment of DS. The goal of physiotherapy is to create physiological prerequisites for restoring the correct position of the body in space (training the strength endurance of the muscles of the trunk, the formation of the muscle corset), stabilizing the scoliotic process, and in the early stages, correcting the deformation. Today, the use of electric currents for therapeutic purposes is well known, and the high efficiency of their use is proved (8).

The most common electrotherapy for DS is electrical stimulation of the back muscles, which is usually carried out using sinusoidal modulated currents. However, the need for action on the contracted muscles is not always taken into account. Short pulse electroanalgesia (TENS therapy) has trophotropic, neurotropic, analgesic, and muscle relaxant effects (8, 9).

An integral component of the comprehensive treatment of such patients is kinesiotherapy, a method of rehabilitation therapy based on movement. Kinesiotherapy can affect both individual links in the pathogenesis of dysplastic pathology of the spine and the entire motor system as a whole (10, 11). The main tasks of kinesiotherapy are stabilization of the vertebral-motor segment, strengthening the muscle corset and accelerating the recovery processes in its structures, normalizing the tone of the paravertebral muscles, restoring healthy posture and fixing optimal motor stereotypes (12).

Adequate kinesiotherapy initiates the maturation of dysplastic tissues, leads to an improvement in the patient's motor activity and remodeling of the affected structure. Stimulation of the motor-visceral mechanism contributes to inhibition or elimination of pathological conditioned reflex connections, mobilization of compensatory functions, and the formation of functional compensation (13).

Recently, new options for kinesiotherapy have appeared that combine dosed unloading of the spine with simultaneous muscle training, for example, on

an inclined plane using the Evminov technique, which is essentially a combination kinesiotherapy. The main goal of CK is to stop the progression and correction of spinal deformity by achieving symmetry of the muscle corset and increasing muscle endurance (14). Today, there has been evidence of the promise of using balneotherapy in the complex treatment of disorders of the musculoskeletal system (15, 16).

A high risk of pathology progression, despite the variety of treatment methods, necessitates not only the use of new physical factors in complex treatment but also the creation of an effective stage-by-stage treatment system for this patient population.

The work aimed to increase the effectiveness of treatment of children with DS I-I degree through the use of complex staged treatment using differentiated approaches to electrotherapy and kinesiotherapy, taking into account the degree of undifferentiated connective tissue dysplasia.

Object and research methods

We examined 167 children aged 7 to 16 years with DS I - II degree. There were 64 boys (38.3%), girls - 103 (61.7%), of which primary school children - 79 (47.3%), and high school children - 88 (52.7%). DS of I degree was diagnosed in 123 (73.6%) patients; DS of II degree was diagnosed in 44 (26.3%) cases. Most of the children had a lumbar-deformity type of deformity - 96 (57.5%) cases, lumbar and thoracic type of DS - in 43 (25.7%) and 28 (16.8%) children, species-like. The severity of disorders in patients with DS of I degree was $(39.3 \pm 1.1)\%$, with DS of II degree - $(41.4 \pm 1.3)\%$.

All examined patients had manifestations of mesenchymal insufficiency. The most common were changes in the musculoskeletal system and the cardiovascular system. Dysplasia of the connective tissue of I degree was in 98 (58.7%) patients, II degree in 64 (38.3%) children, III degree in 5 (3.0%) cases.

All children underwent general clinical and orthopedic examination, the performance of functional tests, X-ray, electromyographic, and laboratory studies. We assessed the severity of disorders (SD), the overall treatment effectiveness (TE), and the coefficient of efficiency (CE) according to the integrated scale for assessing the orthopedic and functional state of children with scoliosis (17).

Children received complex and staged treatment, which included a sanatorium-resort (twice a year)

and outpatient (throughout the year) stages. At the sanatorium stage, treatment and rehabilitation complexes (TRC) were used, which included: orthopedic regimen, climatotherapy, kinesiotherapy and electrotherapy, balneotherapy (sodium chloride baths (SCB)), massage.

Depending on the type of TRC, we used standard and combined kinesiotherapy. Standard kinesiotherapy (SKT) consisted of a set of exercises to strengthen the muscle corset, the formation of the correct body position in space, and the correction of spinal deformity. The duration of one lesson was 30-40 minutes.

Combined kinesiotherapy (CKT) was carried out according to the Evminov technique, on an inclined plane, the duration of one lesson was 20-30 minutes. Exercises CKT was used in the form of complexes for the chest, thoracolumbar, and lumbar types of DS.

We selected kinesiotherapy programs depending on the age of the child, the degree and type of pathological disorders, concomitant pathology, and the level of physical development of the patient.

Electromyostimulation was performed using sinusoidal modulated currents (SMC) on an Amplipulse 5 apparatus with the following parameters: modulation depth - 75%, frequency 80 Hz, current strength — until light vibration was felt, electrode localization — paravertebral at the level of the apex of the curved arc of the convex side. The duration of the procedure for children 7-11 years old was 10 minutes, 12-16 years - 12 minutes, per course - 10 procedures daily.

Short pulse currents (TENS therapy) were performed paravertebrally at the level of the apex of the concave side curvature arc. The duration of the procedure was for children 7-11 years old - 12 minutes, for children 12-16 years old - 15 minutes, a course of 10 procedures daily. In those complexes in which alternation (every other day) of electrical stimulation and TENS therapy was used, electrotherapy was carried out by a general course of 10 procedures (SMC - 5 procedures and TENS therapy - 5 procedures).

Therapeutic massage of the muscles of the back and abdomen was performed according to generally accepted rules, taking into account the age of the child. The duration of the procedure was 10 - 20 minutes., On the course - 15 - 20 daily procedures.

Patients also received sodium chloride baths (SCB) with a concentration of sodium chloride of 20 g / l, water temperature - 36 - 37 ° C. The duration of the

procedure for children 7-11 years old was 10 minutes, for children 12-16 years old - 12 minutes, in a day, on a course - 10 procedures.

Climatotherapy included walking to the sea in the morning and evening (marine dosed aerotherapy), for 1 to 2 hours.

All children received individual correction following the degree of pathological disorders.

All patients were divided into two groups. The first group consisted of 53 children who received kinesiotherapy as monotherapy, and depending on its type, were divided into two subgroups: 1a subgroup consisted of 26 children who received SKT, 1b subgroup - 27 children who received CKT. Patients of the second group (114 children) who received TRC at the spa stage and kinesiotherapy at the outpatient clinic were divided into four subgroups. Subgroup 2a included 27 children who had TRC No. 1 (climatotherapy, SCB, massage, SKT, and electromyostimulation); subgroup 2b included 28 patients who received TRC No. 2 (CTK was used instead of SKT); subgroup 2c comprised 29 children who received TRC No. 3 (additionally TENS therapy), and the 2d group included 30 patients who received TRC No. 4 (electrotherapy with alternating, every other day, effects on the back muscles - electromyostimulation and TENS therapy).

Results and discussion.

After a course of kinesiotherapy as monotherapy at the outpatient stage, in both subgroups of patients of the first group, functional tests improved. In children of subgroup 1b who received CKT, indicators of the functional state of the cardiovascular and respiratory systems were better than in patients of subgroup 1a. Indicators of strength endurance of the muscles of the back and abdomen in subgroup 1b each increased 1.7 times, while in patients 1a of the subgroup, the increase occurred only 1.2 and 1.3 times ($p < 0.05$). SD in patients of subgroup 1b decreased by 12.8%, while in children of subgroup 1a this indicator reduced by 9.4% ($p < 0.001$), and the total TE was $(33.1 \pm 1.3)\%$, which is 5.7% ($p < 0.01$) more than after application of SKT.

All children of the second group had improved orthopedic status and functional tests. However, in patients in the 2c subgroup, the strength endurance of the back muscles increased 1.8 times, the abdomen - 1.7 times ($p < 0.05$), whereas in children of subgroup 2a these data increased, respectively, by 1.4 and 1.3 times ($p < 0.05$).

The SD after the course in the 2b and 2c subgroups decreased by 13.8 and 13.5%, respectively, while in patients of the 2a subgroup - by 11.7% ($p < 0.001$). TE in children of subgroups 2b and 2c was (33.8 ± 1.8)% and (34.2 ± 2.2)%, and in patients of subgroup 2a it was (30.9 ± 2.1)% ($p < 0.05$). In the 2d group, the results of using TRC No. 4 were significantly better. The SD index in children of the 2d subgroup decreased by 20.3% compared with the data before treatment and amounted to (21.3 ± 1.1)% ($p < 0.001$), the CE index increased by 26.5% compared with the 2a subgroup ($p < 0.01$), the TE index was 21.4% higher compared to subgroup 2a and amounted to (52.3 ± 1.3)% ($p < 0.05$) (Table 1). An analysis of the long-term results of treatment of patients of the first group showed that the number of good results when using kinesiotherapy as monotherapy was 37.1%, satisfactory 42.9%, and unsatisfactory 20.0%. In patients of the second group, the best results were achieved in subgroup 2d (CKT at the outpatient stage, TRC No. 4 at the sanatorium stage). The number of good long-term results was 84.6%, satisfactory - 11.5%, unsatisfactory - 3.9%. In children of subgroup 2a (standard kinesiotherapy at the outpatient stage, TRC No. 1 at the sanatorium stage), the results were as follows: good - 45.5%, satisfactory - 31.9%, unsatisfactory - 22.7%. In subgroups 2b and 2c, the treatment results did not significantly differ, although they were significantly better than in subgroup 2a and significantly worse compared to subgroup 2d ($p < 0.05$).

Thus, the analysis of the obtained data showed the advantages of using CKT not only as monotherapy, but also as a component of TRC at the sanatorium-resort stage of treatment, which was manifested in an improvement in the functional parameters of the cardiovascular, respiratory and muscle systems,

stabilometric indicators, a decrease in SD, and an increase in ET.

As for electrotherapy, the obtained results testified to the effectiveness of differentiated bilateral electrotherapy (TENS therapy and electromyostimulation), which contributed to the symmetrization of paravertebral muscle tone.

We consider it possible to recommend the developed system of staged differentiated use of kinesiotherapy and electrotherapy for practical purposes in children with DS I - II degree. It is advisable to use CKT at the outpatient stage, and at the sanatorium-resort stage - TRC with the inclusion of CKT and electrotherapy.

Conclusions.

1. The use of kinesiotherapy in children with DS I-II degree in the form of combined kinesiotherapy at the outpatient stage, and as part of TRC at the sanatorium-resort stage, significantly increases the effectiveness of treatment of this group of patients.
2. Differentiated electrotherapy (TENS-therapy and electromyostimulation) as part of TRC at the sanatorium-resort stage of treatment of children with DS of the I-II degree, allows to halve the severity of pathological disorders and increase the effectiveness of treatment.
3. The introduction of a system of staged differentiated use of kinesiotherapy and electrotherapy in children with grade I - II DS provides good long-term results in 84.6% of patients.
4. A comprehensive assessment of the degree of CTD and the correction of these pathological disorders is an essential component in the formation of individual rehabilitation programs in children with DS of the I - II degree.

Table 1. The result of the use of TRC in patients of the second group, (M ± m)

Indicators		Subgroups			
		2a (n=27)	2b (n=28)	2c (n=29)	2d (n=30)
SD, %	Before TRC	40,9±2,1	41,5±1,4	39,3±1,4	41,7±1,6
	After TRC	29,2±1,3**	27,7±1,1**	25,8±1,2**	21,3±1,1* **
CE		1,36±0,1	1,43±0,1	1,48±0,1*	1,72±0,1*
TE, %		30,9±2,1	33,8±1,8	34,2±2,2	52,3±1,3*

Notes:

1. * - $P < 0.05$ compared to the 2nd subgroup
2. ** - $P < 0.001$ compared to SD before TRC

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