

EVALUATION OF ULTRASOUND DIAGNOSTIC POSSIBILITIES IN REHABILITATION OF MOVEMENT FUNCTIONS IN PATIENTS WITH CEREBRAL PALSY

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Abstract:

Dolzabligi. Currently, various methods are used to diagnose neurological, orthopedic and other syndromes in patients with Cerebral Palsy (CP). In order to objectify the state of the child's movement abilities, the traditional neurological and orthopedic clinical examination is complemented by various assessment scales (spasticity scale, muscle strength, gross motor functions, etc.) [1,2,3]. Despite a certain level of subjectivity, these scales make it possible to form a general idea about the state of the child's motor function, to assess the dynamics of its development against the background of rehabilitation measures. Instrumental diagnostic methods are limited to radiography of the osteoarticular apparatus, myography. Based on the results of the above examination methods, clinical conclusions are made and a decision is made to use one or another method of surgical or neuro-orthopedic treatment [3,4,5]. In the recent literature, the effectiveness and appropriateness of using various treatment methods are widely discussed - these are staged casts, orthopedic surgical interventions, selective fasciofibromyotomy, botulinum therapy in the movement rehabilitation of patients with BMF. Taking into account the targeted surgical intervention, a more objective assessment of the state of the child's motor skills, the readiness of his main structures that ensure the formation of movement is offered. A common and inexpensive method for this purpose is ultrasound (UZT). Until now, ultrasound examination has not been widely used in the practice of rehabilitation of patients with BMF, because there are no uniform methodological approaches, the indications for its use have not been determined, and its objectivity has not been evaluated [6,7,8,9].

The purpose of the study: to evaluate the objectivity of the ultrasound diagnostic method in the comprehensive assessment of the movement status of patients with BMF. To determine the indicators of use in the rehabilitation of this contingent of patients.

Materials and methods:

ultrasound examination of muscles was performed in 196 children with spastic diplegia form of BMF. The control group consisted of 17 children (first group) born with a developmental anomaly of the central nervous system: spinal cord hernia. The second control group consisted of 40 children who underwent a sanatorium-spa rehabilitation course on ENT pathology in the remission stage of frequent colds. Patients in the second group did not constantly take any special drugs, including hormonal drugs. The average age of children is 8.9 ± 6.33 years. All patients and children in the control group underwent clinical and neurological examination. Severity of paresis is on a five-point scale (5 points is normal muscle strength, 4th patient performs movements with resistance (mild paresis), 3rd patient is able to raise the limb without resistance (moderate paresis), 2-movements only in the horizontal plane (deep paresis), 1-minimum movements of the fingers are preserved (deep paresis), 0 there are no active movements at all. All children underwent ultrasound examination of the calf muscles on an ultrasound device

"SSD-1700" (Aloka, Japan). Linear sensors with a frequency of 5-7.5 MHz were used to assess the condition of skeletal muscles. The patient lies in a horizontal position, empty stomach. The transmitter is parallel and perpendicular to the muscle, located in its proximal part. The study was carried out symmetrically on both legs. The scanning angle is 90°. The position of the transmitter depended on constant coordinates that could be seen or felt.

The description of the sonogram included a visual assessment of the muscle structure (linear, homogeneous), localization and type of changes (inflammatory changes, ossifications, generalized or local, homogeneous, symmetrical or absent), the presence of fasciculations. Additional computer analysis of individual standard segments of acquired ultrasound images was performed to quantify the preservation of muscle structure. The following indices were automatically calculated: thickness of the fascial sheath (FG'Q), connective tissue index (BTI), degree of preservation of the characteristic line (XChSD). Based on the obtained data, a conclusion describing the degree of degeneration of a certain muscle was formed.

Results and their discussion. Ultrasound examination is a generally recognized method of diagnosing structural disorders of human organs and systems, including its muscular system. However, the study of muscles with UTT has so far been limited mainly to traumatic injuries, various formations, their localization and assistance in carrying out various manipulations. The study of muscle tissue degeneration using this method was mainly descriptive. In the practice of rehabilitation of patients with BMF, this method is rarely used. Based on the results of studies in groups of healthy children and patients with obvious muscle tissue degeneration, confirmed by the data of clinical and EMG studies, three numerical indicators (thickness of the fascial sheath (FG'Q), the connective tissue index (BTI), the degree of preservation of the characteristic line (XChSD)) made it possible to obtain a reliable description of the events that occur, the events of muscle regeneration and the possible prospects of rehabilitation measures. The obtained research results were automatically processed using a specially developed computer program. FG'Q and BTI indexes made it possible to reliably assess the degree of degeneration of muscle tissue. Results of computer analysis of sonograms.

Table. 1

Comparative analysis of calf muscle ultrasound findings in patients with BMF and control groups (M±m).

Ultrasound indicator	Groups of patients		
	BTI	XChSD	
The first control group (n=17)	11,59±0,12ΔΔ	2,78±0,06ΔΔ	495,39±5,43ΔΔ
BMF children who (n=196)	14,17±0,61	1,97±0,13	688,63±10,20
The second control group (n=40)	9,53±0,28 **■ ■	3,21±0,11 **■ ■	449,83±25,70 **■ ■

Note: the reliability of the differences between the indicators of the first and second control groups: * - p<0.05; * * - p<0.01; between the indicators of the first control group and the group of patients with BMF: Δ - p<0.05, Δ - p<0.01; between the indicators of the second control group and the group of patients with BMF: ■ - r<0.05; ■ ■ - r < 0.01.

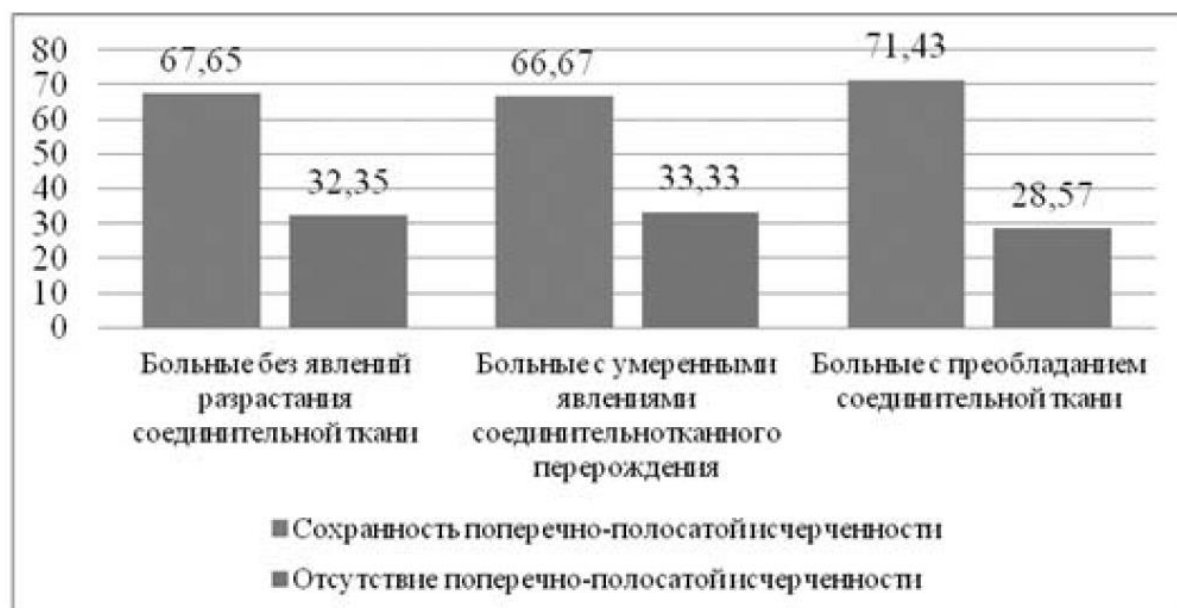
Indicators in two control groups, calculated using a specially developed computer program, describe two diametrically opposite states of muscle tissue: physiological norm and gross pathological changes. The indicators of patients with BMF were more diverse, which made it possible to divide

all children into groups based on the statistical closeness of the obtained data to a certain category of the indicators of the control groups. Accordingly, if the muscle indices were close to those of healthy children, it could be concluded that the muscles of patients with BMF do not have degenerative events. And on the contrary, gross changes in the tissues of children with BMF were shown with indicators that were not statistically different from the indicators of the second control group. All indicators, which were in a statistically reliable interval between the indicators of the control groups, indicated multidirectional processes occurring in the muscle. According to the table, the coefficients obtained for all patients with BMF clearly show that the muscle system of this category of patients does not correspond to the corresponding indicators in the group of healthy children.

A statistically reliable difference in performance between the group of patients with BMF and the group of patients with gross events of muscle tissue degeneration may indicate a certain degree of preservation of muscle structure and rehabilitation potential. Many sources of literature note that muscle tissue has great regenerative potential. For one reason or another, satellite cells released from the shell of dying fibers merge into new fibers, as a result of which regeneration of damaged tissues takes place. As a rule, while maintaining the muscle structure, new muscle fibers are formed in the area bounded by the basement membrane of the old fiber, that is, they replace the damaged fibers. Based on the above results of various studies, it can be assumed that there is a certain potential for muscle fiber recovery in patients with BMF, which can be confirmed by the distribution of XChSD between groups of children with different FG'Q and BTI. Figure 1.

Distribution of patients with BMF according to preservation of normal lines (%)

(Fig.1)



According to the figure, the presence or absence of connective tissue growth does not characterize the degree of muscle degeneration, nor the rehabilitation potential of the muscle. Thus, in a certain number of patients with BMF, the events of connective tissue degeneration (from a clear to moderate degree) are noted, and transverse striations characteristic of muscle fibers are preserved. The preservation of muscle-specific lines proves the existence of intact muscle tissue and, accordingly, the possibility of its restoration or rehabilitation. Thus, UT-indices allow patients to be divided into groups depending on the level of preservation of muscle rehabilitation potential, Fig. 2.

of patients with BMF

distribution of muscles according to rehabilitation potential (%)
(Fig.2)



According to the picture, children with low rehabilitation potential, children with all negative factors of muscle degeneration (predominance of connective tissue, small number of muscle fibers with the absence of a characteristic extension line) 22 of the total children examined by ultrasound (11.22%) was. The number of children whose muscle structure did not change was 46 (23.47%). A group of 128 children (65.31%) had cases of muscle degeneration and unchanged fiber structure.

22 children (11.22%) were the number of children whose muscle structure by all ultrasound parameters was statistically reliably close to the indicators of healthy children. Accordingly, 88.78% of patients with BMF have some degree of pathological changes in the muscles of the legs. Analysis of the clinical presentation of the disease in the group of children who underwent muscle ultrasound showed that the clinical data did not correspond to the identified changes. It should be noted that mild diagnoses were not recorded in any case. All patients were moderate 91 (46.43%) or severe 105 (53.57%). In this case, clear muscle degeneration was noted in patients with moderate severity of the disease and vice versa. Examination of other clinical symptoms showed that the spasticity level averaged 3.30 ± 0.78 points in the group, and the severity of paresis was 3.12 ± 0.73 points. When studying the motor capabilities according to the GMFCS classification, the patients were distributed as follows: only 8 children could move independently (4.08%), walking with restrictions in 44 (22.46%), walking only with devices in 106 patients (54, 08%) could, those who do not act independently - 38 (19.38%). The analysis of the obtained data shows that there are no correlations between the degree of morphological degenerative changes in the muscles, the degree of motor impairment, the degree of spasticity and the strength of the muscles. Accordingly, clinical diagnosis based only on the above symptoms does not allow to assess the potential of the child's ability to move, to develop adequate tactics and strategies of an individual long-term program for the recovery of a sick child.

Based on the obtained results, all patients were divided into rehabilitation groups. Pathological changes in the muscles of the segments of the legs of a child not exceeding 4-5 degrees and the absence of obvious contractures are an indication for carrying out only conservative treatment methods (first group).

Sonogram of the head of the calf muscle in a child with BMF with clear remodeling events
(fourth rehabilitation group).
(fig. 3)



The presence of connective tissue degeneration of the muscle, the preservation of its extension line and the absence of contractures of 4-5 degrees of movement limitations, as well as the activation of metabolic and trophic processes in the muscles are indicators for carrying out conservative rehabilitation methods (second rehabilitation group). Reduction of spasticity with botulinum toxin was not shown in this category of sick children. Obvious contractures are an indication for surgical treatment aimed at their elimination (third group). Then the therapy tactics should be similar, that is, aimed at activating the regeneration processes. A rough level of reconstruction and the absence of a characteristic line of muscles describe a low rehabilitation potential for movement recovery (fourth group). Sick children are recommended to use orthopedic products that allow them to move (at a high level of intellectual development). Surgical treatment of sick children should be carried out in accordance with social guidelines, to ensure the full care of the child (stretching the muscles of the adductor group to increase the volume of lateral extension of the thigh for hygiene measures), 3, Figures 4, 5.

Calf muscle head sonogram of a child with BMF with moderate degenerative events (second rehabilitation group). (fig. 4)



Calf muscle head of a child with BMF without pathological changes (first rehabilitation group) sonogram.

(fig. 5)



Thus, rehabilitation measures aimed at forming a physiological motor stereotype should be carried out taking into account the information obtained about the structural safety of the child's muscular apparatus. Forming a new, physiological stereotype is impossible without saving the muscle fiber. Therefore, in the diagnostic algorithm, it is necessary to use methods that allow an objective assessment of the state of the muscular system before forming a rehabilitation program. The most promising in treatment is the first rehabilitation group. Rehabilitation measures are effective when the method of treatment of sick children of the second and third groups is chosen correctly. The ultrasound method of diagnosing the condition of the muscular system developed in the sanatorium is the most objective in determining the rehabilitation tactics and strategy of patients with BMF. Objectification of the structural properties of muscles allows to form an individual complex of necessary therapeutic measures for each sick child, to avoid the use of useless treatment methods in terms of their effectiveness, thus to optimize costs, and to allocate examined children to rehabilitation groups.

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