ASSESSMENT OF THE RESPIRATORY FUNCTION IN CHILDREN WITH TETRAPARESIS

Rodica PĂULESCU[1], Dorina ORȚĂNESCU[2], LigiaRUSU[2]

[1]*National University of Physical Education and Sport*

[2]*University of Craiova*

Abstract: The recovery of the child with tetra-paresis involves complex and associated therapies, kinetotherapy with physiotherapy and occupational therapy as an essential action direction, the recovery programs having as main characteristic their individualization or adaptation to the needs of each subject. The evaluation of the respiratory function at the time of the initiation of the kinetotherapy program is useful in the development of the respiratory function towards a gradual adaptation of breath which must be the result of a program aimed at the respiratory muscles. These adaptive issues were shown to be more evident in children, so the evaluation of the respiratory function can give useful clues to the orientation of a kinetotherapy program.

Keywords: *cerebral palsy, children, spirometry.*

Introduction

The cerebral palsy was described by a multiple neuromuscular disorder, non-contagious and not-progressive, caused by brain damage in the early stages of its development. Tetraparesis represents the most severe form of spastic cerebral palsy. [1-3] The clinical features of all forms of cerebral palsy resulting in tetraparesis include typical deformities of the trunk, upper limbs and lower limbs, and, in terms of neuromuscular, we are talking about muscle fatigue, spasticity, due to lack of selective motor control.

Over time, one has sought different ways of therapy and treatment for the patients with neurological problems, especially in children with spastic tetraparesis. The complexity of the condition of the patient with cerebral palsy is connected to both the variety of pathologies, having different degrees, and to the specificities of development. The recovery of the neurological patients is one of the most difficult sectors of recovery, due to the complexity of the pathology and to the high costs.

The kinetotherapy means should aim to ensure the needs of oxygen in the muscles by increasing the ventilation, because, in effort, the lung capacity decreases (static lung volume –SLV), while the inspiratory capacity increases (IC), increasing the current volume (CV) that can reach 50% of the vital capacity (VC) in light efforts while, in maximal efforts, the ventilation grows slowly, progressive until the effort ends with rapid decrease after the effort.

Methods

Within the study, a full assessment was carried out on a group of 5 children aged 5-15, body mass index 12.2 to 17.6, diagnosed with cerebral palsy, who had partial motor deficit in the upper and lower limbs, with the addition of respiratory disorders arising from dysfunction of deviation of the spine and the thoracic wall. We mention that the experiment was based on their parents' consent, respecting the principles of the Helsinki Declaration on human studies.

The pulse-oximetry was performed with the help of a digital pulse oximeter, attached to each subject’s index, while performing spirometry, the average harvest time of the results being 4-10s.

There was used the Medika digital spirometer, manufactured in Finland, which is in the endowment of the Research Centre FEFS Craiova. The spirometer was calibrated prior to performing the experiment, the subjects were seated and the record included five deep breaths. The accuracy of these measurements is highly dependent on the subject's effort and cooperation and on the training of the evaluator. [4]

Clinically, the evaluated subjects experienced para and tetraparesis in the context of cerebral palsy.

Results

Table 1 Spirometry

Parameter	Registered value	Percentage to the reference values (%)	Interpretation / comments
FVC	1,89	59%	Restrictive ventilatory dysfunction, moderate severe decrease
	0,17	14	Severe restrictive ventilatory dysfunction
	1,68	62	Restrictive ventilatory dysfunction, medium decrease
	2,93	67	Restrictive ventilatory dysfunction – normal parameters
	2,03	54	Restrictive ventilatory dysfunction, moderate severe decrease
FEV1	1,89	49	Restrictive ventilatory dysfunction, moderate severe decrease
	0,17	17	Severe restrictive ventilatory dysfunction
	1,65	75	Restrictive ventilatory dysfunction, medium decrease
	2,91	81	Restrictive ventilatory dysfunction – normal parameters
	1,83	59	Restrictive ventilatory dysfunction, moderate severe decrease
FEV1/FVC	1	118	Restrictive ventilatory dysfunction, moderate severe decrease
	1	118	Severe restrictive ventilatory dysfunction
	0,98	116	Restrictive ventilatory dysfunction – medium decrease
	0,99	118	Restrictive ventilatory dysfunction – normal parametres
	0,90	107	Restrictive ventilatory dysfunction, moderate severe decrease
FEV1/FEV6	1	118	Restrictive ventilatory dysfunction, moderate severe decrease
	1	118	Severe restrictive ventilatory dysfunction
	0,98	116	Restrictive ventilatory dysfunction, medium decrease
	0,99	118	Restrictive ventilatory dysfunction – normal parameters
	0,90	107	Restrictive ventilatory dysfunction, moderate severe decrease
PEF	2,89	43	Restrictive ventilatory dysfunction, moderate severe decrease
	0,60	23	Severe restrictive ventilatory dysfunction
	2,45	50	Restrictive ventilatory dysfunction, medium decrease
	5,85	80	Restrictive ventilatory dysfunction –

			normal parameters
	2,64	41	Restrictive ventilatory dysfunction, moderate severe decrease
50%FVC	2,30	50	Restrictive ventilatory dysfunction, moderate severe decrease
	0,27	16	Severe restrictive ventilatory dysfunction
	1,66	105	Restrictive ventilatory dysfunction, medium decrease
	3,95	88	Restrictive ventilatory dysfunction – normal parameters
	2,04	51	Restrictive ventilatory dysfunction, moderate severe decrease

From the spirometry results, there is noted that all subjects have restrictive ventilatory dysfunction caused by the decrease of the compliance in the chest wall due to muscle weakness in the respiratory muscles.

Pulse-oximetry - in the subjects selected for this preliminary study, the oxygen saturation was determined: before spirometry, throughout the entire spirometry recordings and during the first minute from the completion of the spirometry.

Thus, the average value of SO2 ranged between 90-92%, which is below the normal value, explained by the existence of hypoventilation caused by motor deficit (muscle fatigue) of the chest and paravertebral muscles, which demonstrates the importance of such investigation in children with tetraparesis, even before clinical signs of restrictive respiratory dysfunction.

Based on the normal values of FEV1, FVC, VC 80-120% and the definitions corresponding to the obstructive and restrictive notions, we have analyzed the results. The percentage values of FVC below 80% indicate a restriction, while the value of FEV1 / FVC less than 80% indicates the existence of an obstruction. Thus FEV1 indicates the normal limits in one subject and the remaining values below normal. The normal value for this age group is 2.77 l / sec, while for the evaluated subjects, it was around under 1 l / sec.

The average range is 58.2% which indicates a location in the moderate area of the assessment of FEV1 due to the restrictive respiratory failure, requiring the development of the respiratory muscles.

PEF has a normal average value of 2.88 l / s, and expresses, as previously mentioned, the exhale speed, the instant maximum expiratory flow. This parameter has values below normal in 4 of the subjects.

The FVC values are below normal, averaging 46.43% versus the predictive value, which is closely related to the development in FEV1, indicating a severe respiratory disability, which justifies the introduction of specific exercises to develop the trunk muscles.

The FEV1 / FVC report falls within normal values for the age group (86.1%), which argues that the low normal values of the two parameters FEV1 and FVC have no pathological significance, in our case, these results being explained by muscle and kinetic insufficiency of the chest, age-specific for the subjects evaluated, but that allows us to orient the training program. The average predictive value is 83%, the subjects being sitauted in report to this value at a level of 117%. CV current volume registers values well below normal, explained by the existing muscle imbalances.

The analysis of all parameters as a whole, with relevant elements related to the FEV1, FVC, PER, indicates that the subjects evaluated had, at the beginning of the assessment, a specific pattern of ventilatory restrictive dysfunction, where FVC is less than 80%, FEV1 is low and the ratio FEV1 / FVC is normal. These are explained also by the existence of dorsal scoliosis, deformity of the chest and muscle-oligamentar failure, elements that support their approach in the training program for further improving physical capacity.

We believe that the implementation of a recovery program focused also on the development of the muscle elements that produce improved respiratory mechanics should contain 4-6 weeks of muscular training of the paravertebral and chest muscle.

The results obtained can be influenced by the recovery programs representing indicators which can be monitored.

Conclutions

The study has found that the average of the decrease in ventilatory function of FVC is 49%, which means a significant decrease in the ventilatory capacity. These results require the establishment of a respiratory kinetotherapy program based on chest muscle tone, posture correction of scoliosis by paravertebral muscles tone, coordination of breathing time for a minimum duration of 5-7 minutes.

References:

[1]. Yoshida M, Nakajima Uchida Yamaguchi T, Nonaka T, et al., *Characteristics of lower-jaw-position sensation with respect to oral-jaw functions in patients cerebral palsy.* Pediatric Dental Journal 2004; 14(1)23-8

[2]. The Merck Manual of Medical Information, *Cerebral palsy. Second Home Edition*, Chapter 284(http://www.merck.com/mmhe/index.html).

[3] Mirea A, Morcov C., Onose G. , Pădure L. , *Aspects of quality of life in families with children with cerebral palsy*, PRACTICA MEDICALÅ – VOL. IX, NR. 4(37), AN 2014, p.246-250.

[4]. Singh D., Verma R., Garg R., Singh M., Shukla R., Verma S., (2011), *Asssessment of respiratory functions by spirometry and phrenic nerve studies in patients of amyotrophic lateral sclerosis*, Journal of the Neurological Sciences, vol.306, issues 1-2, pp.76-81