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A Study on Efficacy of Respiratory Exercises Coupled with Neuro Developmental Treatment on Pulmonary Function of Children with Spastic Quadriplegic Cerebral Palsy

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Cerebral palsy is a group of condition characterized by motor dysfunction due to non-progressive brain damage early in life. They may also have decreased mobility, restriction in physical activity and limitation in functional capacities, Along with motor dysfunction, children with cerebral palsy can have abnormality of respiratory function This study was intended to study the efficacy of Respiratory exercises along with Neurodevelopmental treatment in Pulmonary function of children with Spastic quadriplegic cerebral palsy. From the special school of NIEPMD, 30 children with spastic quadriplegic Cerebral Palsy who met the inclusion and exclusion criteria was selected. They were randomly allocated into 2 groups. Group A (Control group) consists of 15 participants who were given Neuro-developmental Therapy for 45 minutes, 5 days in a week for 6 weeks. Group B (Experimental Group) consists of 15 participants who were given Neurodevelopmental Treatment along with Respiratory Exercises for 45 minutes (30 min and 15 min), 5 days in a week for 6 weeks. Informed consent is obtained from the parents of the participants. Pre and post values of FVC, FEV1, FEV1/FVE % and PEF were obtained using pulmonary function tests and statistical analysis was done. Paired-t test value of pretest and post-test of FEV1 & FVC shows statistically very significant ($p<0.01$) and FEV1/FVC % & PEF shows statistically significant ($p<0.05$) in experimental group. The results on analysis between groups on improvement of FVC, FEV1, FEV1/FVC% & PEF shows significant improvement by independent sample t test value ($p<0.05$). From the result of this study, it was concluded that Respiratory exercises along with NDT is more effective on improving the lung function in children with spastic quadriplegic cerebral palsy than that of conventional NDT program alone.

Keywords : Pulmonary Function , Cerebral palsy, Ventilatory parameters, Neuro developmental treatment (NDT), Respiratory exercises.

Cerebral palsy is a group of condition characterized by motor dysfunction due to non-progressive brain damage early in life. Along with motor dysfunction, children with cerebral palsy can have abnormality of respiratory function such as poor airway clearance, decreased chest wall mobility, respiratory muscle weakness and lung distensibility.

Prevalence of cerebral palsy is in the range of 1.5 to 2.5 per 1000 live births. The rate is higher in males than in females. It is 1.3 times more common in males, 8 to 10 % of the cases are due to

perinatal damage, while genetic factors contribute to 2% of the cases, birth asphyxia, especially a prolonged one, increases the risk of cerebral palsy, accounting for about 10% of the cases, preterm birth and underlying pathological lesions, such as periventricular hemorrhage; venous infarcts are also contributory.

Children with cerebral palsy breath in a poorly coordinated fashion, relying on the abdominal muscle instead of the chest muscles, eventually movement of the chest is restricted and the chest muscles weaken resulting in reduced expansibility of the lungs, as a result the ability to take a larger breath is impaired.

Normal breathing is slow, regular, nasal only, diaphragmatic, invisible and inaudible consisting of a small inhalation and relax for the exhalation and the exhalation is followed by an automatic pause of about 2 seconds. Normal breathing at rest is about 18-30 breaths per minute. Children with Cerebral Palsy breath more slowly when compared to normal children, and at rest the phase of their respiratory muscle activity appears to be different. In healthy children, the maximal activity of the abdominal muscles occurred later after maximal chest expansion, whereas in children with Cerebral Palsy, abdominal muscle activity occurred earlier, due to decreased firing of muscles of the chest. Normal breathing is not just a matter of inhaling the good air and exhaling the bad used air, the entire respiratory parameters such as rate, depth, timing; pattern and consistency of breath are all important to the delicate balance of respiratory and metabolism.

Children with Cerebral Palsy who have respiratory problems show a poorly coordinated pattern of respiratory muscles, shallow and low breathing volume, and decreased cardiopulmonary capacity. All the factors increase the risk for respiratory complications such as recurrent pneumonia, atelectasis; bronchiectasis, chronic obstructive and restrictive lung disease in these children. Respiratory dysfunction is known to be a leading cause of death among children with Cerebral Palsy. However respiratory dysfunction in children with Cerebral Palsy has not been well studied, possibly due to difficulty in testing the respiratory parameters as the child will not cooperate for it.

Young Hyun *et al* in their study concluded that understanding respiratory functional level of children with Cerebral Palsy will be important for clinical assessment and therapeutic intervention. Respiratory training may improve the respiratory functional level of the children with Cerebral Palsy.

METHODOLOGY

Study design: Experimental study
Sample Size : 30
Group A Control Group – 15 Nos
Group B Experimental Group – 15 Nos
Sampling method : Convenient sampling (Random Sampling)
Study setting : NIEPMD Special school
Study Duration : 6 weeks

Inclusion criteria

Children with spastic quadriplegic Cerebral Palsy

1. Age of children ranging between 6-14 years of both gender.
2. Children who could understand and follow commands given by the therapist
3. Children who were able to sit independently or with support using assistive devices
4. Children who blow air independently

Exclusion criteria

1. Children with spastic diplegia; athetoid; ataxic; flaccid Cerebral Palsy
2. Children with impaired cognitive function
3. Children who received any recent surgical procedures or botulinum toxin injections
4. Convulsion

MATERIALS

- Computerised spirometer
- Computer
- Weighing machine
- Incentive spirometry

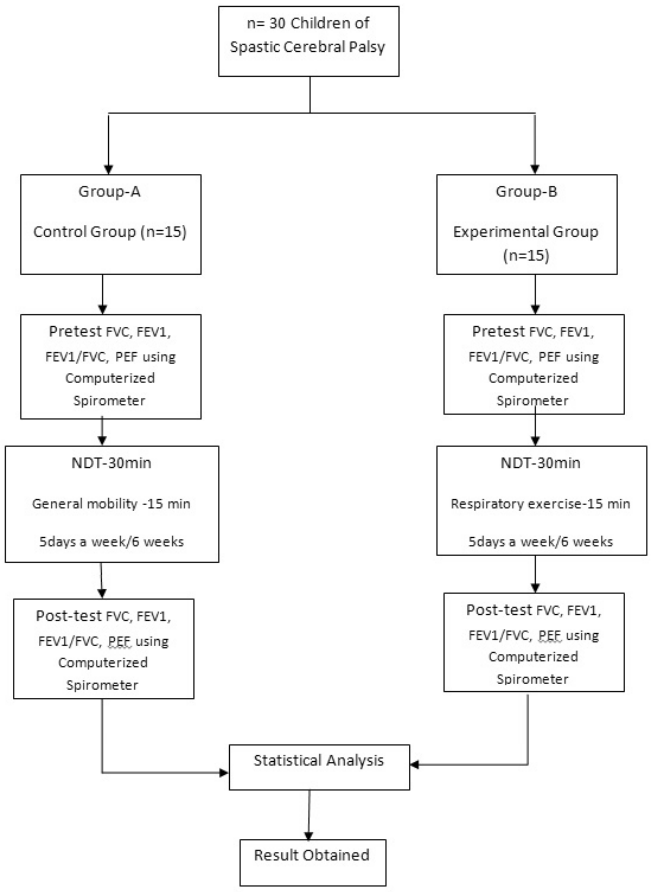
Variables

Dependent variable : Pulmonary function test
Independent Variable : Respiratory exercises; Neuro Developmental

Treatment

Outcome measure

1.FVC
2.FEV1
3. FEV1/FVC Ratio
4. PEF



Procedure

From the special school of NIEPMD, 30 children with spastic quadriplegic Cerebral Palsy who met the inclusion and exclusion criteria was selected. They were randomly allocated into 2 groups. Group A (Control group) consists of 15 participants who were given Neuro-developmental Treatment and general movements for 45 minutes (30 min and 15 min), 5 days in a week for 6 weeks. The exercise program follows the basics principles of Neuro-developmental therapy such as key points of control, handling methods; facilitatory and inhibitory techniques. And general movements include moving of shoulders, rotation exercises and elbow movements. Group B (Experimental Group) consists of 15 participants who were given Neurodevelopmental treatment along with Respiratory Exercises for 45 minutes (30 min and 15 min), 5 days in a week for 6 weeks. Respiratory Exercises includes breathing exercises, Active shoulder/ shoulder girdle ROM exercises; Diaphragmatic breathing exercise; thoracic expansion exercise and incentive spirometry. Informed consent is obtained from the parents of the participants. Pre and post values of FVC, FEV1, FEV1/FVC % and PEF were obtained using pulmonary function tests and were taken statistical analysis.

Data analysis

The outcome values obtained were tabulated in Microsoft Excel 10 spread sheet, and were exported to SPSS statistics 20.0 version for windows 7 for statistical analysis.

The effects of the intervention on the changes from pre to posttest values in both groups were analyzed using Paired 'T' test for within group analysis and independent sample 'T' test for between group analyses.

The P value was chosen as per the description given by SPSS statistics for windows 7 ultimate version.

RESULTS

The study was done on 30 subjects who consists of 15 subjects in each group with the duration of 6 weeks intervention.

Mean value of independent variable before the pretest an post test of FEV1, FVC, PEF & FEV1 /FVC % values of Respiratory Exercises with Neurodevelopmental treatment (NDT) shows significant difference in improvement.

Paired-t test value of pretest and post test of FEV1 & FVC shows very significant in experimental group.

Paired-t test value of pretest and post test of FEV1/FVC %& PEF shows significant in experimental group.

The results on analysis between groups on improvement of FVC, FEV1, FEV1/FVC% & PEF shows significant improvement by independent sample t test value ($p<0.05$).

Table 1. Description of P value:

P value	Description	Summary
< 0.001	Extremely significant	***
0.001 to 0.01	Very significant	**
0.01 to 0.5	Significant	*
> 0.05	Not Significant	NS

DISCUSSION

The results of our study have shown that Respiratory Exercises along with NDT helps in improving the expansibility of lungs in experimental group when compared to NDT program alone. The improvement in lung function

Table 2. Within group analysis of ' T' test in FVC of Experimental and Control group

S.No	Group	Analysis	Mean ± SD	T- Value	Significance
1	Experimental Group	Pre -test	1.03687 ± 0.780385	-3.232	0.006**
		Post - test	1.65553 ± 0.976147		
2	Control Group	Pre -test	0.471301 ± 0.121689	-2.842	0.013*
		Post - test	0.396140 ± 0.102283		

From the above table it indicates that, there is a Statistically significant improvement in both the groups

Table 3. Within group analysis of ' T' test in FEV1 of Experimental and Control group

S.No	Group	Analysis	Mean + SD	T- Value	Significance
1	Experimental Group	Pre -test	0.74007 + 0.594382	-3.629	0.003**
		Post - test	1.28307 + 0.845454		
2	Control Group	Pre -test	0.32653 + 0.197419	-2.280	0.039*
		Post - test	0.59787 + 0.435999		

From the above table it indicates that, there is a Statistically significant improvement in both the groups

Table 4. Within group analysis of ' T' test in FEV1/FVC % of Experimental and Control group

S.No	Group	Analysis	Mean + SD	T- Value	Significance
1	Experimental Group	Pre -test	61.27273 + 25.521925	-2.398	0.031*
		Post - test	80.63400+ 16.781738		
2	Control Group	Pre -test	52.78000+ 25.758604	-2.215	0.044*
		Post - test	65.30200 + 9.991159		

From the above table it indicates that, there is a Statistically significant improvement in both the groups

Table 5. Within group analysis of ' T' test in PEF of Experimental and Control group

S.No	Group	Analysis	Mean + SD	T- Value	Significance
1	Experimental Group	Pre -test	1.38153 + 0.908011	-2.778	0.015*
		Post - test	2.12933+ 1.274954		
2	Control Group	Pre -test	0.97413+ 0.58338	-2.352	0.034*
		Post - test	1.23853 + 0.642078		

From the above table it indicates that, there is a Statistically significant improvement in both the groups

Table 6. Between the group analysis of Respiratory exercises with Neurodevelopmental treatment (Experimental group) Vs Neuro developmental therapy (Control group)

S.No	Area	Analysis	Group	Mean + SD	T- Value	Significance
1	FVC	Post -test	Experimental Group	1.65767 + 0.982390	-2.336	0.011*
			Control Group	1.01873+ 0.396140		
2	FEV1	Post -test	Experimental Group	1.28307+ 0.845454	-2.790	0.027*
			Control Group	0.59787 + 0.435999		
3	FEV1/ FVC %	Post -test	Experimental Group	80.66267 + 16.805197	-3.043	0.039*
			Control Group	65.30200+ 9.991159		
4	PEF	Post -test	Experimental Group	2.32933+ 1.233205	-3.039	0.049*
			Control Group	1.23853 + 0.642078		

is documented by significant difference in respiratory parameters noted in pulmonary function test. Although NDT program has been widely used as conventional method of treating clients with cerebral palsy, Respiratory exercises when added with NDT program showed significant changes in respiratory function. Respiratory function is vital to the maintenance of cellular metabolism for maintenance of life. Recent studies suggest that children with cerebral palsy show respiratory dysfunction due to multiple neuromuscular symptoms such as paralysis of respiratory muscles, limited chest expansion, increased tone of the muscles, inefficient biomechanics of breathing structures, faulty posture, increased thoracic kyphosis and abnormal neuromotor development.

Gonzalez coast *et al* in their study stated that chest wall restriction is one of the indication for recovery for these respiratory symptoms, respiratory training programs have increasingly been viewed as clinical necessity. Based on the increasing need Respiratory Exercises is implemented in this study to support its efficiency in improving pulmonary function. Respiratory Exercises given in this study includes Deep Breathing exercises, Diaphragmatic strengthening exercises, thoracic expansion exercise and active exercises to shoulder girdle. Abdominal muscle prepare the diaphragm at the end of expiration for next inspiration. The diaphragmatic strengthening exercises given to the clients in this study improved FVC values in experimental group may be because of the above mentioned reason. Improvement in the lung volume is by improving ventilation and by reducing airway resistance which further results in improving lung compliance.

The overall result of this study shows that respiratory parameters FVC,PEF & FEV1 are improved significantly in the experimental group. Probable reason for improvement in breathing exercises reduces the shoulder tension, facilitates the use of muscles of the chest resulting in thoracic expansion, thereby it automatically improves the lung expansion. Respiratory comprise results in complication such as shortness of breath, poor airway clearance and so forth. These problems deteriorate the quality of life and are life threatening, hence respiratory training should be considered in clients with cerebral palsy.

CONCLUSION

From the result of this study, it was concluded that the Respiratory Exercises along with NDT is more effective on improving the lung function in children with spastic quadriplegic cerebral palsy than that of conventional NDT program alone.

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