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Evaluation of Respiratory Muscle Strength in Children with Cerebral palsy

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Abstract

Cerebral palsy (CP) is a developmental disorder of movement and posture caused by a

Nonprogressive lesion to the immature brain, which can induce a variety of developmental

motor disabilities and clinical presentations. Studies have revealed that children with CP are exposed to a risk of pulmonary dysfunction and parenchymal lung disease. These problems further deteriorate capacity for physical activity in daily life and are critical factors impeding recovery and development of motor function. Most rehabilitative treatments have intensively focused on recovery of motor function and compensation of residual physical capacity. Understanding the respiratory functional level of children with cerebral palsy is important for clinical assessment and therapeutic intervention and rehabilitation.

Method: Sixty subjects according to inclusion criteria were included in the study. Subjects were divided into two groups (Control & Experimental) .Experimental group were further divided into three groups (i.e., GMFCS level I, GMFCS level II, and GMFCS level III). The demographic details of all subjects like name, age, gender, height, weight, BMI, Respiratory muscle strength (Maximum inspiratory pressure-MIP (cmH_2O), Maximum Expiratory Pressure-MEP (cmH_2O) were taken.

Conclusion**:** The study showed that children with cerebral palsy showed a significant lower respiratory strength than aged match control group. Further, children in experimental group who belonged to the GMFCS level III had significantly lower respiratory muscle strength when compared to other two groups i.e. GMFCS levels I and II.

Introduction

Cerebral palsy (CP) is a developmental disorder of movement and posture caused by a Nonprogressive lesion to the immature brain, which can induce a variety of developmentalMotor disabilities and clinical presentations.[1]The symptoms causing the most concern is motor dysfunction characterized by abnormalityof muscle tone and movement pattern, poor postural control, motor developmental delay, and so forth. Motor dysfunction causes limitation of functional activity and results in secondary complications related to the musculoskeletal system. On account of this clinical importance, most rehabilitative treatments have intensively focused on recovery of motor function and compensation of residual physical capacity. [2] Many recent studies have revealed that children with CP are exposed to a risk of pulmonary

dysfunction and parenchymal lung disease. Clinical symptoms consist of coughing and poor air clearance, decreased chest wall mobility, insufficient respiratory muscle function, etc. These problems further deteriorate capacity for physical activity in daily life and are critical factors impeding recovery and development of motor function.[2]

Cerebral palsy (CP) is one of the major neurological diseases that cause physical dysfunction such as sensorimotor and respiratory dysfunction. Motor dysfunction induces paralysis or weakens respiratory muscles, and this gives rise to an abnormal distorted chest, restriction of physical activity, and delayed development of the cardiopulmonary system.[3]Cerebral palsy (CP) commonly involves pulmonary dysfunction due to motor disability of the respiratory muscles caused by brain injury, which results in a high incidence of mortality or long-term hospitalization.[4]

Children with CP who have respiratory problems show a poorly coordinated pattern of respiratory muscles, shallow and low breathing volume, and decreased cardiopulmonary capacity. These symptoms often cause parenchymal lung pathology (widespread micro-athelectasis and reduced lung distensibility), which impairs of motor development and performance of functional activities in their lives.[4]

Clinically, movement-related disorders have traditionally been classified according to type of muscle tone abnormality(i.e., spastic, athetoid, and ataxic type) and involved limb (i.e., hemiplegic, diplegic, and quadriplegic type. Apart from the traditional classification, it is an important clinical factor for evaluation of functional level for motor ability in children with CP.[1]Therefore, currently, the Gross Motor Functional Classification System (GMFCS) has been widely adopted in clinical settings for diagnosis of functional motor level in CP.[1]

Along with motor disability, children with CP can have abnormality of respiratory function, such as poor airway clearance, respiratory muscle weakness, and lung distensibility. These symptoms are caused by consequences of neuromuscular impairment resulting from brain injury. [1]

Numerous previous studies have reported a close association of respiratory function with motor ability. However, little evidence regarding differences in respiratory function depending on functional level of motor ability in CP has been published.[1] In children it will help to manage and follow up neuromuscular diseases and pulmonary diseases besides being used in rehabilitation programs, weaning and postoperative processes. Understanding the respiratory functional level of children with cerebral palsy is important for clinical assessment and therapeutic intervention and rehabilitation.

Methodology

Children within age group of 7-17 years diagnosed with spastic diplegic and hemiplegic cerebral palsy with cognitive and language abilities sufficient to fulfil respiratory muscle strength evaluation were undertaken for the study. Parents of the children were explained about the procedure in the language best understood by them and a written consent was taken. A total of thirty children with CP who were classified as below level III of the GMFCS were recruited for this study. They were divided into three groups (i.e., GMFCS level I, GMFCS level II, and GMFCS level III).

The demographic details of the subjects like name, age, gender, height, weight, BMI, present and past medical history was noted. The subject underwent the respiratory muscle strength testing. Respiratory muscle strength was assessed by measuring the maximal inspiratory pressure (MIP or PImax) and the maximal expiratory pressure (MEP or PEmax). The MIP reflects the strength of the intercostal muscles and other inspiratory muscles, while

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the MEP reflects the strength of the abdominal muscles and other expiratory muscles. Data was analysed using SPSS software 16.

Results

Table 1:

DEMOGRAPHICS	Normal Group MEAN(SD)	Cerebral palsy MEAN(SD)
AGE	11.25±1.8	11.96±3.35
BMI	18.7±3.3	19.49±2.70

Graph 1:

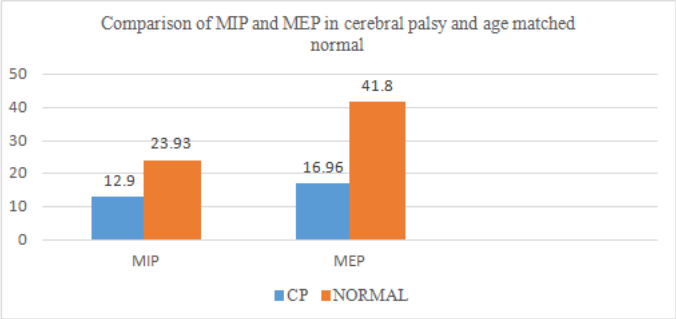

Table 2:

	CP	NORMAL	p Value
MIP (cmH2O)	12.9 ± 5.16	23.93 ± 4.26	0.00*
MEP (cmH2O)	16.96± 5.31	41.8 ± 4.27	0.00*

Inference:

On the basis of p value which is 0.00*, it can be interpreted that children with cerebral palsy show a significantly lower respiratory muscle strength than age matched normal children.

Graph 2:

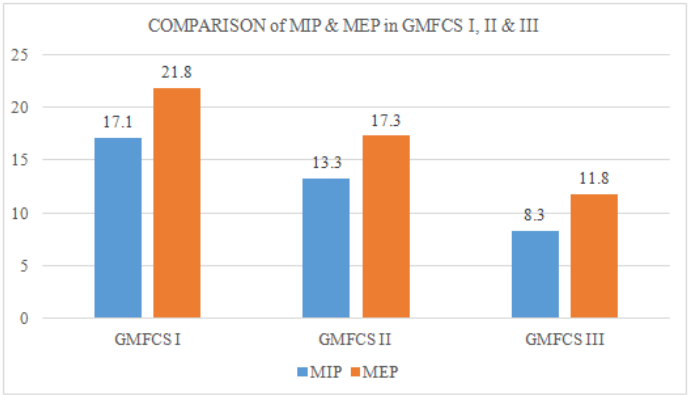

Table 3:

	GMFCS I	GMFCS II	GMFCS III	p Value
MIP(cmH2O)	17.10 ± 4.86	13.30 ± 3.30	8.30 ± 2.86	0.00*
MEP(cmH2O)	21.8 ± 4.75	17.30 ± 2.54	11.80 ± 2.48	0.00*

Inference: On the basis of p value it can be interpreted that children with cerebral palsy at level III of GMFCS show a significantly lower respiratory muscle strength as compared to level I and II.

Discussion

In this study, we compared the respiratory muscle strength of children with spastic diplegic and hemiplegic CP with those of children with normal development. The result showed that the children with spastic cerebral palsy showed significantly lower respiratory muscle strength compared with children with normal development.

One viable explanation for the significant difference in respiratory pressure between children with spastic CP and those with normal development is that both diplegic and hemiplegic CP are characterized by weakness of limb as well as respiratory muscles.[2]

Neurological involvement of a group of muscles related to respiratory function in CP has already been well established by many prior studies. [2]

Recent studies have suggested that children with CP show respiratory dysfunction related to multiple neuromuscular symptoms, such as weakness of respiratory muscles, limited chest expansion, inefficient biomechanics of breathing structures, and abnormal neuromotor development.[2]

In the current study, we also found that children with CP who belonged to the GMFCS level III group had significantly lower respiratory pressure compared with the two other groups (i.e., GMFCS levels I and II).

This result indicates that children with CP who walk with an assistive mobility device in most indoor settings have

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poor respiratory muscle weakness. Accordingly, it would be highly expected that children with CP who walk with an assistive mobility device in most indoor settings could have accompanying non-parenchymal pulmonary dysfunctions due to poor respiratory function and muscle weakness.[1]

According to functional GMFCS level, children categorized into GMFCS levels I and II had independent walking ability, whereas those categorized into GMFCS level III usually had some limitations in indoor environments that required use of self-support or walking-aid devices for independence. Accordingly, we reasoned that children who could not walk independently would have low respiratory function and muscle strength due to a decline in lung capacity accompanied by limitation of functional movement.[1]

Decline of physical activity in pathologic conditions could lead to development of peripheral muscle abnormalities and dysfunction due to muscle weakness, increased muscle fatigue, and reduced oxidative capacity.[1]

Several previous studies reported a close association of respiratory function and muscle strength with amount of daily living activities or functional exercise capacity in children with neurological disease.[6] Therefore, the above findings were supported by those of many previous studies, suggesting that deteriorated respiratory ability could be attributed to a decrease in functional activity due to abnormal movement and ambulatory function. Also, a significant difference was found between the levels I & II of the GMFCS, suggesting lower respiratory muscle strength in level II when compared to level I of GMFCS.

One important explanation proved in a study could be that, a child with CP at GMFCS level I can perform gross motor skills such as running and jumping and participate in physical and dynamic activities. In contrast, a child with CP at GMFCS level II cannot participate in physical and dynamic activities owing to his/her limited abilities.[5]

Physical function, such as cardiovascular fitness, is known to be closely related to respiratory function. In children, active physical activity accompanied by normal motor development is essential for growth of organs related to respiration in terms of respiratory muscles, lung parenchymal and airway structures. [1]

The findings indicate that decrease in functional motor ability as classified by the GMFCS could be accompanied by respiratory function and respiratory muscle weakness. Therefore, careful evaluation of respiratory ability and its related muscle function will be required in cases of children with CP who have lower physical activity.[1]

Conclusion

The study shows that on comparing the respiratory muscle strength between children with cerebral palsy and age matched normal children, children with cerebral palsy show a significant lower respiratory strength than aged match normal children.

Therefore, respiratory function in children with CP should be carefully evaluated and should receive more attention in a rehabilitation setting.

This study also shows that children with cerebral palsy who belonged to the GMFCS level III group have significantly lower respiratory muscle strength when compared with the two other groups (i.e., GMFCS levels I and II). Therefore, clinical manifestations regarding respiratory muscle strength will be required in children with CP who demonstrate poor physical activity.

Clinical Implication

1. The findings in this study will help develop clinical guidelines for rehabilitative specialists to be used in evaluation of respiratory function in children with CP.

2. After evaluating the respiration function, it should receive more attention in the rehabilitation of children with cerebral palsy along with neurological development.

3. Assessment of the functional level in children with cerebral palsy will help the specialists to improve their

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physical activity which are limited and also improve their cardio respiratory function.

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