Influence of Postural Control on Ventilatory Functions for Patients with Post Polio Syndrome

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ABSTRACT

The purpose of the study was to investigate the effects of designed physical therapy program including high voltage pulsed galvanic stimulation and exercises on postural control, and consequently on some parameters of the ventilatory functions in post polio patients. The study included forty post polio syndrome patients having moderate non structural thoracic scoliosis (20°-40°) from both sexes (13 boys, 27 girls). Their ages ranged from 12 to 14 years (12.3 years). They were randomly assigned into two equal groups. A program of strengthening and stretching exercises for back muscles was conducted to treat the control group, while the study group received the same treatment regimen in addition to High Voltage Galvanic Stimulation (HVGS) for the same group of muscles. Treatment of both groups continued for 20 successive weeks, five sessions/week. Evaluation procedures including radiological examination (Cobb's angle), and pulmonary functions tests including vital capacity (VC) and forced expiratory volume in 1st sec (FEV_1) were carried out for all patients before and after the suggested period of treatment. The results at the end of treatment revealed significant reduction in mean values of Cobb's angle, and significant improvement in the measured ventilatory functions tests for the study group. The changes in the corresponding mean values of all measuring parameters in the control group were statistically non significant. The significant improvement of the measured ventilatory functions of the study group may be attributed to improvement of posture control via correction of spinal curvature in post polio patients.

INTRODUCTION

Many individuals who have survived poliomyelitis are now concerned with new muscle weakness developing years after the initial paralytic infection. This has been termed post polio syndrome[8]. Post polio syndrome (PPS) is defined as a progressive neuromuscular syndrome characterized by new weakness, fatigue, muscle and joint pain, difficulty in swallowing and breathing and several other symptoms[10]. The exact mechanism of these symptoms is unknown; however, a number of etiologies has been proposed. It has been found that in PPS, terminal axonal degeneration occurs with a subsequent loss of isolated muscle fibers[9]. One of the proposed etiologies is motor unit dysfunction due to overuse or premature aging on large motor units. The neuron may become exhausted and wear out which makes them

susceptible to dysfunction. The other proposed etiology is musculoskeletal overuse, depending on the muscle damage caused by polio and the mechanical strain on joint, ligaments and tissues, weakness may follow[12].

Scoliosis is one of the common problems resulting from paralytic poliomyelitis. It is a complex three dimensional deformity with lordosis, lateral deviation and axial rotation of spine[18]. Respiratory deterioration may appear many years after acute poliomyelitis and has been reported in patients with or without a history of ventilatory support during the acute phase of illness. Patients with neuromuscular disease can develop ventilatory failure if their vital capacity is about 50% or lower than predicted[17].

Neuromuscular electrical stimulation is used as an adjunct to physical therapy to increase strength, range of motion, motor control and co-ordination[3]. High voltage pulsed galvanic stimulation is a relatively new form of neuromuscular electrical stimulation that uses voltages between 100 and 500 v[16]. High voltage galvanic generators produce a high voltage current with a high peak intensity and short duration. The high peak intensity which produced as a twin peaks are safe and penetrating more deeper than the currents produced by the low voltage generators. Thus direct stimulation of deep nerves and muscles can be very effective. The muscle can be stimulated to contract in isolation or as a part of a total pattern of movement. It is used for relieving pain, reducing oedema, healing ulcers, increasing mobility of the joint, improving muscle strength and increasing blood flow[14].

The purpose of the study was to determine the effect of designed physical therapy program including (HPGS) and specific remedial exercises on correction of spinal curvature, and the influence of improving posture on ventilatory functions in post-polio patients.

SUBJECTS, INSTRUMENTS AND PROCEDURES

I. Subjects

Forty post polio syndrome patients having moderate thoracic non structural scoliosis (13 boys, 27 girls) participated in this study. Their ages ranged from 12 to 14 years (X: 12.3 years). They were selected randomly from Institute of poliomyelitis and physical medicine in Imbaba according to the following criteria:

1- All subjects were diagnosed as having thoracic scoliosis, secondary to poliomyelitis (functional curve).
2- The angle of scoliotic curve ranged between 20° to 40° (Cobb's angle).
3- Absence of any structural deformities.
4- All patients did not receive electrical stimulation at any time before the study.
5- Each patient was instructed to wear a medical shoe with raised heal to compensate any shorting of the affected lower limb for all the day.

Subjects were assigned randomly into two groups of equal numbers group I (study group) and group II (control group).

II. Instruments

- Bennett X-Ray apparatus was used to determine the Cobb's angle for both groups.
- Vitalograph: Compact spirometer cat no 42000 was used to assess VC (L) and FEV_1 (L) for all subjects of the study.
- High voltage pulsed galvanic stimulator (EST 211) was used to stimulate back muscles on convex side for the study group.

III. Procedures

(A) Evaluations

- Evaluation for scoliotic curve:

The Bennett X-Ray apparatus was used before and after treatment to detect the degree of spinal curvature via an anterior posterior views, with the patient standing. The lateral spinal curve (Cobb's angle) represented the measurement of thoracic curve[2].

- Evaluation of ventilatory functions included vital capacity (VC) and forced expiratory volume in 1st sec (FEV_1). These parameters were measured in liters (L).

a- Vital capacity (VC): The patient was asked to inspire maximally, then exhaling lung air completely into spirometer.

b- Forced expiratory volume in 1st sec (FEV_1): The patient was asked to inspire maximally then exhaling lung air as forced and rapid as possible into spirometer[13].

(B) Treatment

Group I (study) received stimulation with HVPGS for facilitation of spinal muscles according to technique of Alon and Kantor[1]. The wave form was a twin peaked pulse with 60μ sec spacing between pulses. The pulse duration was 80μ sec. The pulse frequency was ranged from 20-30 PPS to provide maximum contraction without producing muscle fatigue. The high voltage current was surged to allow muscle relaxation. The contraction gradually increases or decreases in a way similar to voluntary muscle contraction 1:5 on/off cycle to produce muscle contraction stimulation. It was applied for 20 minutes once daily for 5 times/week for 20 weeks.

Each child was put in a comfortable prone lying position with head in mid position. The electrodes were placed symmetrically over back muscles above and below the thoracic curvature in the convey side. The distance between the two electrodes depends on curve and trunk size (6-10 cm). The spinal movements were palpated by placing finger tips on the spinous processes.

In addition, subjects in both groups received a program of specific exercises, as recommended by Kisner & Colby[7]. These exercises were done under the supervision of physiotherapist. The patients were given an illustrated copy of the exercise program and instructed to perform it once daily for 30 minutes. These exercises included stretching and strengthening exercises for back muscles. Each type of exercises was repeated 10 times each session, five days/week for 20 successive weeks.

I. Stretching exercises on the concave side of the curve from different positions.

From prone position: The patient was stabilized at iliac crest.

- The patient was asked to touch his knee with his arm on the convex side of the curve while stretching the other arm overhead.
- Then asked to bring hands behind the head and lift the head and trunk laterally away from the concavity.
- Patient was asked to stabilize the upper trunk by holding onto the edge of the hips and legs laterally, bents the trunk away from the concavity.

From sitting position: The patient's arms were stretched overhead bilaterally to bends the trunk laterally away from the concavity.

From side lying position: The patient was lying on the convex side with a rolled towel at the apex of the curve and the top arm stretched overhead.

DISCUSSION

Faulty postural control mechanism is one of the most common limiting motor deficit in post polio syndrome. It results in a complex setting problem. The faulty postural mechanism may be attributed to back muscular weakness. Lack of postural control leading to scoliosis of the spine, which directly may affect, the rib cage, and in turn results in distortion of the lung out lines with hyper inflation of one hemithorax and compression of alveoli on the other side[9].

Before starting the treatment all the patients in the current study demonstrated reduction in the tested parameters of ventilatory functions as compared with predicted values. The reduction in mean values VC (L) reflected moderate restriction of small airways, while reduction in mean values of FEV_1 (L) revealed a moderate obstruction of large airways. These could be attributed to decrease the efficiency and poor co-ordination of the breathing mechanism due to scoliosis which result from lack of postural control due to weakness of back muscles. Accumulation of secretions and compression on the alveoli are other factors, in this reduction[11].

Post polio patients have low postural muscle tone in the axial back muscles, and they tend to have decreased active control of the trunk muscles when they are in the upright posture[10].

Most of the published studies have centered on using the electrical stimulation as an adjunct to physical therapy. High voltage galvanic stimulation can be used in improving muscle strength as it has the advantage of penetrating deeper than the current produced by low voltage generators. The clinical uses and therapeutic effects of HVGS on modulation of pain and increasing strength in healthy and injuried muscles were documented in the literatures[14].

In the present study significant changes were observed in VC & FEV_1 for the study group at the end of the treatment. This improvement may be attributed to postural adjustment due to strengthening of weak back muscles via use of HVGS.

The results of the current study come in agreement with findings of Carmick[5], who reported that functional electrical stimulation may be a useful tool for enhancing muscle strength, motor control, increasing sensory awareness and assisting motor learning and coordination. These findings were found to be contradicted with Walker et al.,[15] who reported that electrical stimulation does not increase muscle strength.

The significant changes of VC (L) after completion of treatment in the study group may be attributed to improvement of the posture control mechanism. This reflects the improvement of coordinated action of respiratory muscles & increase back muscles control. The improvement of back muscles control may be due to activation of upper back extensors and reduction in tightness of sternal portion of pectoralis major[6].

The significant changes which were recorded in the mean value of FEV_1 in response to treatment for study group indicated a valuable improvement in the large air ways obstruction which can be attributed to correction of scoliotic curve and reduction in Cobb's angle via correction of scoliotic curve. This leads to proper muscle action and expansion of the collapsed alveoli, as a result of increased size of thoracic cage and ability of patients to get of their secreations[4].

The significant increase in mean values of ventilatory function parameters measured in this study, revealed a variable improvement in

the postural control for study group which represented by reduction in Cobb's angle, this improvement can be attributed to correction of scoliotic curvature.

CONCLUSION

From the previous results, it can be concluded that 20 weeks of HVGS with exercise program are efficient to improve ventilatory functions for post polio syndrome patients via postural control.

The results of this study indicated significant effects of HVGS with exercises program on posture with consequent improvement of ventilatory functions for post polio syndrome patients.

It was suggested that the same program could be used as an effective procedure for controlling posture, improving ventilatory functions and functional activity for other similar conditions and for longer period of time.

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الملخص العربي

تأثير تدريبات التحكم في القوام على الوظائف الرئوية عند المرضى المصابين بمجموعة الأعراض المتأخرة لشلل الأطفال

الهدف من هذه الدراسة هو قياس تأثير برنامج للعلاج الطبيعي يحتوي على تدريبات للتحكم في وضع القوام مع التنبيه بتيار جلفاني متقطع ذو فرق جهد عالي وكذلك قياس العلاقة بين التحكم في وضع القوام ووظائف تهوية الرئة عند المرضى المصابين بمجموعة الأعراض المتأخرة لشلل الاطفال0

أجريت هذه الدراسة على أربعين شخصا مصابين بأنموذج ما بعد شلل الأطفال ويعانون أيضا من انحناء جانبي في الفقرات الصدرية (20 -40 [5]) وكان عدد المرضى (13) ولد و (27) بنت وتتراوح أعمارهم ما بين (12-14) عاما (متوسط 12.3 عام) ولقد تم تقسيمهم عشوائيا إلى مجموعتين متساويتين المجموعة الضابطة تلقت تدريبات لتقوية واطالة عضلات الظهر بينما تلقت المجموعة التجريبية بالإضافة إلى هذه التدريب تنبيها كهربيا بواسطة التيار الجلفاني ذو فرق جهد عالي ، ولقد استمر العلاج للمجموعتين لمدة عشرون أسبوعا بمعدل خمس جلسات في الأسبوع ولقد كانت إجراءات تقويم الحالات تحتوي على قياس زاو ية كوبس عن طريق صور الأشعة وقياس وظائف الرئة عن طريق قياس السعة الحيوية وحجم هواء الزفير في الثانية الاولي وذلك قبل وبعد العلاج 0

ولقد كانت النتائج في نهاية العلاج تشير إلى انخفاض حقيقي في متوسط الحسابي زاوية كوبس وتحسن حقيقي في الوظائف الرئوية التي تم قياسها في المجموعة التجريبية بينما لم تسجل المجموعة الضابطة أي تغيرات ذات دلالة إحصائية واستنتج الباحثون إن هذه التغيرات في المجموعة التجريبية ترجع إلى التحسن في انحناءات العمود الفقري .