103 - DIAPHRAGMATIC MUSCLE STRENGTHENING THROUGH FUNCTIONAL ELECTRICAL STIMULATION

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INTRODUCTION

Currently respiratory therapy using a large arsenal of techniques to respiratory muscle strength, among these, are the breathing exercises, the use of equipment such as boosters and electrical stimulation. The latter provides a low cost, easy implementation and controversial results depending on the current literature.

Functional electrical stimulation (FES) is a form of treatment that uses low-frequency electrical current to cause contraction of muscles paralyzed or weakened due to upper motor neuron lesion , such as strokes, spinal cord injuries or cerebral skull , cerebral palsy , among other (DUARTE , Armenian FS , 2011) . The response to electrical stimulation of the diaphragm has been used over time for studying the mechanisms of action and as a means of ventilatory support in patients with high cervical spinal cord injury or in patients with alveolar hypoventilation. The principal clinical application of this technique, however, has been to evaluate the function of the phrenic nerve and diaphragm paralysis.

To evaluate the effect of muscle strengthening using an equipment which makes the measurement of inspiratory pressure (MIP - maximal inspiratory pressure, inspiratory FM) and expiratory (MEP - maximal expiratory pressure , expiratory FM) known for manometer . In this test, the volunteers performed three reproducible maneuvers, both the MIP , as for MEP , while the highest value was computed . All volunteers remained seated and making use of a nose clip to prevent escapes (NEDER, 1999) . The MIP has its normal value comprised in a young adult , in the range of -90 to -120 cmH2O , whereas the MEP has its normal value comprised in a young adult , in the range of +100 to +150 cmH2O . It is known that from the age of 20 is an annual decrease of 0.5 cmH2O these values (Azeredo, 2002).

As for measuring the amount of air that enters and leaves the lungs spirometry, which can be accomplished with a slow breathing or forced expiratory maneuvers are used. The test helps in preventing and allows the diagnosis and quantification of respiratory disorders. Spirometry should be part of the assessment of patients with respiratory symptoms or known respiratory disease (Pereira , 2002) . For this test the subjects were stimulated vigorously to that carried out in an explosive exhalation maneuver onset and during exhalation the therapist observed the individual and encouraged positively to the effort is maintained for the time necessary. The objectives of this study are to analyze the manometer and spirometry before and after the application of FES on the diaphragm and compare respiratory conditions of patients after Technique in an attempt to prove the efficacy of functional electrical current to the respiratory muscle strengthening.

MATERIALS AND METHODS

This research is in a non- randomized clinical trial , conducted at the Rehabilitation Clinic FAG - Assisi School Gurgacz between the months of September- October 2013. The population was composed of individuals of both sexes , which were included in this study all those who met the criteria for inclusion and exclusion , and signed a consent form.

The sample consisted of 20 healthy individuals who contemplated the inclusion criteria of this study , the selection was made randomly. Being the inclusion criteria : age between 21 and 65 years, have any diseases of the respiratory system , with availability to attend the site on the date and time stipulated and signed the consent form . Exclusion criteria were : having pulmonary, cardiovascular or neurological diseases , present some contraindication to the device (FES) have any physical impairment that would prevent them from participating in the study , not accepting participate and / or do not sign the consent form under 21 years of age and with cognitive impairment . Was approved by the ethics committee of Assisi College Gurgacz with the number 156/2013 protocol.

Data collection was through an interview with the individual, individually in a room . The interview consisted of 6 questions , 3 open and 3 closed , followed by initial evaluation consisting of: Blood Pressure , Respiratory Rate , Heart Rate , Oximetry , ventilatory pattern , peripheral perfusion , Diaphragmatic Force (Scale Cuello) , Manovacuometry and Spirometry (Medical Microlab ® 3300) with the subject seated , with the application of FES parameters : pulse frequency : 40 Hz , pulse width : 250 ms , rise time : 1 second ; contraction time : 1 second ; fall time : one second ; relaxation time : 2 s; stimulation time : 20 minutes; intensity : according to the sensitivity of the patient (Azeredo , 2002; Geddes , 1991) , in supine position and with arms along the body (was also asked who performed contractions synchronized with the firing of electrical current) and finally re : Manovacuometry Spirometry and again with the subject seated .

At the end of the collection , the present study was entirely typed and edited with Microsoft ® Word 2010 program. Data were tabulated and compared statistically with the IBM ® SPSS Statistics 20.0 software .

RESULTS AND DISCUSSION

Based on the survey it was found that the average age of individuals who participated in the survey ranges from 21 to 65 years. With an average age of 33.90 ± 12.37 years . As inferred the gender of the 20 individuals interviewed hears predominance in males, where sex: 70 % were male and 30 % female .

As with smoking , the prevalence of nonsmokers , which were found 55 % of non-smokers and 45 % smokers among nonsmokers some subjects had discontinued smoking for over ten years and it was found , so the literature says individuals who left the vice with more than 5 years time they run the same risk of cardiorespiratory diseases a person who has never smoked in his life . For averages of vital signs such as Respiratory Rate obtained 18.15 ± 2.23 , 74.60 ± 9.47 Heart Rate , SpO2 97.95 ± 1.05 and 60 % had a blood pressure of 120/80 mmHg, and can be seen that there was a good anthropometric homogeneity , since they are mostly within the normal range .

As shown in Table 01 all subjects had an increase in FEV1 , FVC and FEV1/FVC also the vast majority , thus proving the improvement in ventilatory capacity both inspiratory and expiratory in all subjects undergoing treatment with functional electrical current.

	Pré-FES			Pós-FES		
Sujeito	VEF1	CVF	VEF1/CVF	VEF1	CVF	VEF1/CVF
Sujeito 1	2,63	3,02	83	2,63	3,02	86
Sujeito 2	3,02	3,36	90	3,15	3,46	91
Sujeito 3	2,43	2,43	100	2,78	2,8	99
Sujeito 4	3,84	4,33	88	3,95	4,75	83
Sujeito 5	2,94	3,04	96	2,94	3,04	100
Sujeito 6	3,91	3,91	100	4,29	4,29	100
Sujeito 7	3,23	4,03	80	3,53	4,22	83
Sujeito 8	3,96	4,24	93	4,13	4,68	88
Sujeito 9	3,45	3,69	93	3,45	3,69	98
Sujeito 10	2,63	3,02	83	2,63	3,02	86
Sujeito 11	2,92	3,22	91	2,92	3,22	92
Sujeito 12	2,93	3,23	91	2,93	3,23	92
Sujeito 13	2,97	3,15	94	2,97	3,15	97
Sujeito 14	3,45	3,69	93	3,45	3,69	98
Sujeito 15	2,43	2,53	96	2,78	2,8	99
Sujeito 16	2,93	3,23	91	2,93	3,23	92
Sujeito 17	2,63	3,02	83	2,63	3,02	86
Sujeito 18	2,97	3,15	94	2,97	3,15	97
Sujeito 19	2,63	3,02	83	2,63	3,02	86
Sujeito 20	2,93	3,23	91	2,93	3,23	92
Média	3,04	3,33	90,65	3,13	3,44	92,25
Desvio padrão	0,45	0,50	5,60	0,49	0,58	5,79

Table 01 - Results and spirometry pre - post evaluation.

In Table 02 the values obtained through the manometer test, which found that all subjects in this trial had an increased respiratory muscle strength are presented . As much as the increase in inspiratory and expiratory pressure was not significantly elevated for all participants to be a single application of this protocol , the effects of the application of this technique have proven effective momentarily . According to Morgan et al . , MIP and MEP have been used to identify the risk of respiratory failure and predict survival in patients with neuromuscular diseases.

	Pré-FES		Pós-FES	
Sujeito	Plmax	PEmax	Plmax	PEmax
Sujeito 1	80	100	100	120
Sujeito 2	80	80	90	90
Sujeito 3	120	90	150	100
Sujeito 4	140	120	170	160
Sujeito 5	100	90	110	110
Sujeito 6	140	100	180	140
Sujeito 7	120	120	140	160
Sujeito 8	130	130	160	150
Sujeito 9	80	80	100	100
Sujeito 10	90	115	120	130
Sujeito 11	80	80	110	100
Sujeito 12	110	120	140	160
Sujeito 13	120	110	150	130
Sujeito 14	110	100	130	120
Sujeito 15	90	80	115	120
Sujeito 16	130	130	140	150
Sujeito 17	140	120	160	140
Sujeito 18	120	120	140	130
Sujeito 19	110	110	130	140
Sujeito 20	130	120	150	150
Média	111,00	105,75	134,25	130,00
Desvio padrão	20,95	16,98	24,15	21,45

Table 02 - Results pre and post - manometer .

This research was limited to a single therapy session for each individual by the fact that most of the sample would be unavailable to stay back and continue the treatment . Another factor that contributed to the small sample size was that there were constant clashes between the hours of availability of subjects and the night called semesters .Therefore , we suggest to develop further studies with a larger quantity of sample and with a greater number of applications of this technique trying to keep track of activities conducted by sample and further study on this technique of improving respiratory capacity , which in this study was effective both in ventilation and in the degree of inspiratory and expiratory force.

CONCLUSION

We conclude this work , the application of FES was effective in increasing muscle strength, because there was an improvement in diaphragmatic activity in subjects who participated in this research . But having been a single application of this technique in each individual, gain muscle strength demonstrated in post FES review probably returned to baseline values , so further studies with a larger number of samples and technical applications can be realized.

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ABSTRACT

The aim of this study was to analyze the final results to prove the effectiveness of the application of functional electrical stimulation on diaphragm in increased respiratory muscle strength in healthy patients. The study included 20 healthy subjects of both sexes, with male predominance of 70% and with an average age of 33.90 ± 12.37 years. Initial evaluation, application of 20 minutes FES and final evaluation: a single session for each individual, approximately 40 minutes, where it was held was held. Where spirometry, maximal inspiratory pressure (MIP) and maximal expiratory pressure (MEP) were assessed before and after each session. Statistical analysis of data was performed by the Kolmogorov-Smirnov test ($p<0.05$) except for initial FEV1/FVC ($p>0.05$). All study subjects were positive and satisfactory results can therefore conclude that the application of FES was effective in increasing of respiratory muscle strength.

KEYWORDS: Electric Stimulation, Diaphragm, Muscular Strength.

RÉSUMÉ

Le but de cetteétudeétaitd'analyser les résultatsdéfinitifs pour prouverl'efficacité de l'application de la stimulation électriquefonctionnellesur le diaphragmeune augmentation de la force musculairerespiratoire chez les patients sains. L'étude a inclus 20 sujetssains des deux sexes, avec uneprédominance masculine de 70% et avec un âgemoyen de 33,90 ± 12,37 années. L'évaluationinitiale, l'application de 20 minutes FES etévaluation finale: uneseule session pour chaqueindividu, à environ 40 minutes, oùil a eu lieu a eu lieu. Oùspirométrie, pressionmaximaleinspiratoire (MIP) etpressionexpiratoiremaximale (MEP) ontétéévaluésavant et après chaque session. L'analysestatistique des données a étéeffectuée par le Kolmogorov-Smirnov test ($p<0,05$) à l'exception de FEV1/FVC initiale ($p>0,05$). Tous les sujets de l'étudeontétépositifs et des résultats satisfaisants peuventdoncconclurequel'application de la FES a étéefficacedansl'augmentation de la force musculaire.

MOTS-CLÉS: Stimulation Électrique, Diaphragme, Force Musculaire.

RESUMEN

El objetivo de este estudiofueanalizarlos resultados finales para probarlaeficacia de laaplicación de laestimulación eléctrica funcional enel diafragma enun aumento de lafuerza muscular respiratoriaen pacientes sanos. El estudioincluyó a 20 sujetossanos de ambos sexos, conpredominiodel sexo masculino de 70% y con una edad media de 33,90 ± 12,37 años. Inicial de evaluación, aplicación de 20 minutos FES y evaluación final: se realizó una sola sesión para cada individuo, de aproximadamente 40 minutos, donde se llevó a cabo .Cuandolaespirometría, lapresióninspiratoria máxima (MIP) y lapresiónespiratoria máxima (PEM) fueronevaluados antes y después de cada sesión . El análisis estadístico de losdatos se realizó mediante laprueba de Kolmogorov-Smirnov test($p<0,05$) a excepción de inicial FEV1/FVC ($p>0,05$). Todos lossujetos de estudiofueron positivos y, por tanto, los resultados satisfactorios se puede concluir que laaplicación de FES fue eficaz enel aumento de lafuerza muscular.

PALABRAS CLAVE: Estimulación Eléctrica, Diafragma, Fuerza Muscular.

FORTALECIMENTO DA MUSCULATURA DIAFRAGMÁTICA ATRAVÉS DE ESTIMULAÇÃO ELÉTRICA FUNCIONAL

RESUMO

O intuito do presente estudo foi analisar os resultados finais a fim de comprovar a eficácia da aplicação de eletroestimulação funcional sobre diafragma no aumento da força muscular respiratória em pacientes saudáveis. Participaram do estudo 20 indivíduos saudáveis de ambos os sexos, sendo de predomínio masculino de 70% eapresentando uma idade média de 33,90 ± 12,37 anos. Foi realizada uma única sessão para cada indivíduo, de aproximadamente 40 minutos, onde foi realizado: avaliação inicial, aplicação de 20 minutos de FES e reavaliação final. Foram avaliadas a espirometria onde, a pressão inspiratória máxima (PImax) e pressão expiratória máxima (PEmax), antes e após cada sessão. A análise estatística dos dados foi realizada pelo teste Kolmogorov-Smirnov ($p<0,05$) exceto para VEF1/CVF inicial ($p>0,05$). Todos os sujeitos da pesquisa obtiveram resultados positivos e satisfatórios, podendo assim concluir que a aplicação de FES mostrou-se efetiva no aumento de força muscular respiratória.

PALAVRAS-CHAVE: Estimulação Elétrica, Diafragma, Força Muscular.