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ORIGINAL RESEARCH

Observational practice of incentive spirometry in stroke patients

Íllia N.D.F. Lima[a,*], **Guilherme A.F. Fregonezi**[b], **Rêncio B. Florêncio**[a], **Tânia F. Campos**[b], **Gardênia H. Ferreira**[b]

[a] *Faculdade de Ciências da Saúde do Trairi, Universidade Federal do Rio Grande do Norte (UFRN), Natal, RN, Brazil*
[b] *Laboratório de Desempenho PneumoCardiovascular e Músculos Respiratórios, Departamento de Fisioterapia, Universidade Federal do Rio Grande do Norte (UFRN), Natal, RN, Brazil*

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Abstract
Background: Stroke may lead to several health problems, but positive effects can be promoted by learning to perform physical therapy techniques correctly.
Objective: To compare two different types of observational practice (video instructions and demonstration by a physical therapist) during the use of incentive spirometry (IS).
Method: A total of 20 patients with diagnosis of stroke and 20 healthy individuals (56 ± 9.7 years) were allocated into two groups: one with observational practice with video instructions for the use of IS and the other with observational practice with demonstration by a physical therapist. Ten attempts for the correct use of IS were carried out and the number of errors and the magnitude of response were evaluated. The statistic used to compare the results was the three-way ANOVA test.
Results: The stroke subjects showed less precision when compared to the healthy individuals (mean difference 1.80 ± 0.38) 95%CI [1.02–2.52], $p < 0.0001$. When the type of practice was analyzed, the stroke subjects showed more errors with the video instructions (mean difference 1.5 ± 0.5, 95%CI [0.43–2.56] ($p = 0.08$)) and therapist demonstration (mean difference 2.40 ± 0.52, 95%CI [1.29–3.50] ($p = 0.00$)) when compared to the healthy individuals.
Conclusion: The stroke subjects had a worse performance in learning the use of volume-oriented incentive spirometry when compared to healthy individuals; however, there was no difference

* Corresponding author at: Laboratório de Desempenho PneumoCardioVascular e Músculos Respiratórios, Departamento de Fisioterapia, Universidade Federal do Rio Grande do Norte, Campus Universitário Lagoa Nova, Caixa Postal 1524, CEP: 59072-970, Natal, RN, Brazil.
E-mail: illialima@yahoo.com.br (Í.N. Lima).

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between the types of observational practice, suggesting that both may be used to encourage the use of learning IS in patients with stroke.

Introduction

Stroke is a neurological disorder characterized by a focal disturbance of cerebral function due to the interruption of normal blood flow that usually leads to persistent dysfunction depending on the structures that have been affected.[1] The primary focus of the rehabilitation of these patients is based on motor learning. This learning process corresponds to the acquisition of new movement patterns and consequent retention of relevant information regarding the tasks to be performed.[2]

Stroke impairments may contribute to learning and attention deficits. Attention is essential for retaining information for subsequent interpretation and possible storage in long-term memory. On the other hand, its absence may impair learning directly.[3] The organization and feedback during practice are variables that significantly influence the treatment plan strategies in the rehabilitation of neurological patients.[4]

According to Schmidt,[2] the relearning of an activity can be determined by the physical therapist's direct instruction, a common practice in physical therapy. The therapist can demonstrate the goal of the movement or technique to be performed by the patient.[5]

According to the social learning theory of Bandura,[6] the relearning of an action can be enhanced through observational learning. One example is that the physical therapist can be replaced by video, film, or photographs of the task to be performed by the patient.

Observational practice is processed when an observer reproduces the actions demonstrated by a model, so a new action is incorporated into his repertoire.[5–7] Tasks with virtual elements provide an additional advantage since they increase the number of repetitions and the time of practice.[8]

The evaluation of the performance of a task can demonstrate the influence of teaching strategies on learning. This evaluation takes into account three factors: (1) precision, i.e., the number of errors when trying to perform the task; (2) speed; and (3) magnitude of response, i.e., the number of attempts until reaching a consistent response.[4–9] Respiratory therapy has several techniques that rely on learning for greater effectiveness. One of these techniques is incentive spirometry (IS), which promotes lung expansion, reduction of regional differences in ventilation and perfusion, alveolar recruitment, and improved pulmonary ventilation.[10,11] This technique is widely used in clinical practice for diseases that restrict chest wall movement, reducing expansion. In stroke patients, pulmonary ventilation is often compromised due to the loss of respiratory muscle contraction efficiency, either by hemiparesis or hemiplegia.

The aim of this study was to gain a better understanding of motor learning in patients after stroke by comparing the effects of two different types of observational practice (video instructions vs. demonstration by a physical therapist) during the use of IS.

Method

Participants

The study sample consisted of 40 participants of both genders. Of those, 20 were hemiparetic individuals with a clinical diagnosis of stroke determined by computed tomography, age between 39 and 74 years, time since stroke of 1–7 years, and preserved cognitive ability according to the Mini-Mental State Examination (score of at least 20 points for illiterate, 25 for 1–4 years of schooling, 26.5 for 5–8 years, 28 for 9–11 years, and $\geq$29 for more than 11 years of education). The other 20 participants were healthy individuals with preserved cognitive ability and without cardiac, respiratory, or neurological disease, matched to the other group for age, gender, and body mass index (BMI). All participants who presented fatigue and/or dyspnea during the learning test were excluded.

The study was approved by the Research Ethics Committee of Universidade Federal do Rio Grande do Norte (UFRN), Natal, RN, Brazil (protocol number 095/11) and conducted in accordance with Resolution 466/12 of the National Health Council. All participants agreed to take part in the study by signing an informed consent form (ICF).

Non-probability sampling was used to select the participants, and randomization to the type of observational practice was performed by drawing lots. The sample size was calculated according to data collected from 10 volunteers breathing at rest and during the IS. The effect size was calculated by standard deviation of the volunteers' tidal volume. Considering a significance level of 0.05 and a statistical power of 0.80, the ideal sample was estimated to be 20 subjects for the experimental group.

The mean quantity of errors and attempts was considered to calculate the effect size. A Cohen f of 1.06 was found, considering an α error probability of less than 0.01 ($p < 0.01$) with 0.95 power. Based on the previous findings, the study effect is considered large.

Procedures

First, the participants of the experimental group were evaluated for cognitive function using the Mini-Mental State Examination (MMSE).[12,13] After that, their neurological impairment level was assessed using the National Institute of Health Stroke Scale (NIHSS).[14] Finally, post-stroke motor function was evaluated with the Functional Independence Measure (FIM).[15,16] The control group was evaluated as well.