



CORRELATION OF SPASTICITY WITH FUNCTIONALITY OF SPASTIC INDIVIDUALS AFTER PHYSIOTHERAPY TREATMENT ASSOCIATED WITH HERBAL MEDICINE DERIVED FROM *ALPINIA ZERUMBET*

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ABSTRACT

Spasticity interferes with the individual functionality that sometimes needs to be medicated and perform physiotherapy. Study aimed to correlate functionality with spasticity in spastic subjects after treatment of physiotherapy, associated with herbal medicine derived from *Alpinia zerumbet*. In clinical monocentric and prospective were analyzed 20 subjects after one month of treatment with physiotherapy associated with herbal medicine. Analyzed was International Classification of Functioning (ICF), Independence Measure Functional instrument (Enviro FIM-motor tasksTM) and Ashworth Scale (ASH) through Wilcoxon test, Correlation Pearson and Chi-Square, considering $p < 0.05$. Was found compromised in the ICF strength function with tetraparesis (57%) severe spasticity (42.8%); moderate muscle structure (55.5%); partial strength was (100%), on both sides (88%); moderate disability to activity (83.3%) and participation (66.6%) in arm and hand; and for environmental factors, the drug was intense facilitator (45%). Before and after treatment there were correlation in the lower scores FIM- motor tasksTM with greater severity in function domain strength ($r = -0.71$; $p = 0.0009$; $r = -0.56$, $p = 0.014$); and without correlation in the ASH, after treatment ($r = -0.05$; $p = 0.75$). Was possible to verify that herbal medicine associated with physiotherapy contributed for the increase of individual functionality with sequels due of the Pyramidal Syndrome (PS).

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INTRODUCTION

Spasticity is a Pyramidal Syndrome (PS) disorder based in a neuromuscular dysfunction. Chronically increased of intracellular calcium (L-type voltage Ca²⁺ channel) up-regulated and chronically altered calcium levels subsequent

activation change of the intramuscular calcium-activated proteases (Calpains) causing dramatic muscle lesions have been described (Smith *et al.*, 2009). Increased stiffening of titin and the consequent increase in fibre stiffness could be important to stabilize the ordered arrangement of myofilaments. Recent study (Beckendorf and Linke, 2015), make a case for the emerging importance of oxidative modifications of the titin springs in regulating myocyte elasticity and 'passive' stiffness under oxidative stress

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conditions. Oxidative modifications have been shown to increase the activity of several protein kinases, including protein kinase A (PKA), protein kinase G (PKG), protein kinase (PKC) and calmodulin-dependent protein kinase II (CaMKII) (Steinberg, 2013). Spasticity is a major challenge to the rehabilitation team with increase passive tension (PT) intrinsic changes in the skeletal muscle characterized as any restriction or loss of ability in the performance of basic tasks (Elbasiouny, 2010). In this context the International Classification of Functioning, Disabilities and Handicaps, known more commonly as ICF classifies physiological body functions; body structures; activity and participation; and environmental factors. Its importance is evidenced for analyze the functional compartment on functions, structures, performance and capacity, environmental and personal aspects (World Health Organization, 2013). Already the measure of Enviro FIM- motor tasksTM and *Ashwort Scale* are international protocols used for evaluate individual functional performance determined by the task and muscle spasticity.

Spasticity interferes in function and usually needs be treat with medication. Exist a variety of strategies available for treatment for of spasticity as oral medications or injectable and surgical intervention, besides physiotherapy. The herbal medicine (phytomedication) the basis of essential oil of the *Alpinia zerumbet* (EOAz) (Maia et al., 2016). The characteristics the sample of EOAz utilized in this study were reported by Santos et al. (2011) presenting his main monoterpenes found, being they: terpinen-4-ol (37.62%), 1,8-cineole (17.58%), gama terpinen (11.77%) and para-cimeno (10.67%). Recent study (Santos et al., 2011) showed that EOAz (OEAs, synonymy) induced response significant decreases of the L-type voltage Ca²⁺ channel gated in a dose-dependent manner. Because compared to other currents treatment, it must to be noted that OEAz enhanced modulation on the spasticity and contractile performance after a short period (Maia et al., 2016; Cândido and Xavier-Filho, 2012). Study aimed to correlate functionality with spasticity in spastic subjects after treatment of physiotherapy, associated with herbal medicine derived from *Alpinia zerumbet*.

MATERIALS AND METHODS

Alpinia zerumbet

Plant register voucher specimen in the city of Aracaju (Sergipe, Brazil, 10°55's, 37°03'w) in June of 2003, and exposed in the Herbarium the Federal University of Sergipe (ASE # 8245). And identification of these oil compounds was performed by gas chromatography/mass spectrometry (GC/MS), and the results have previously been published (Santos et al., 2011).

Study design and participants

Clinical study monocentric and prospective sample was 20 volunteers with one month of treatment (10 sessions) for physiotherapy associated with herbal medicine derived from *Alpinia zerumbet* (Figure 1). Study released by Scientific Ethical Committee, opinion delivered (# 1.802.317) and in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki). The Certificate of Presentation for Ethical Appreciation Tiradentes University was CAAE- # 56717516.1.0000.5371.

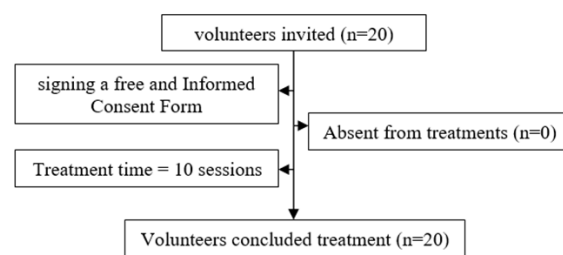


Figure 1. CONSORT of voluntarios of study: All the participants with criteria Inclusion and exclusio who were admitted for treatment in the Motor Rehabilitation Center of one University during the semester were invited to participate in the study (n=20). None patients had allergies dermal and/or to EOAz and hypotensive

Selection for convenience of participants in group was determined by forwarding physiotherapy treatment of patient with spasticity in a rehabilitation center in Brazil during from the school period to university. Participants with spasticity for neuronal sequel due to tetraplegia, paraplegia or hemiplegia (Spinal cord injury or Stroke) were included. Participants excluded with presented dermal allergies to the EOAz and/or were hypotensive (systemic arterial pressure equal to or less than 100 / 60mmHg); in addition to presenting arthrogenic contractures. Subjects agreed to participate in the study, signing a free and Informed Consent Form.

Dosage the drug derived from *Alpinia zerumbet*

OEAz treatment was realized with vegetal oil diluted (33%) and his extraction was by steam drag. In cases of tetraparetic and hemiparetic commitment the doses were 0.05 mg/ 2 Kg in and 0.05 mg/ 4 Kg, respectively. The medication application site was the spasticity muscle, having the total dose per individual divided by these commitment muscles quantitative.

Procedures

Procedures in the Kinesiotherapy associated with the herbal medicine EOAz. Participants were analyzed by ASIA standardized evaluation: motor and sensory level of each side of the body, ASIA impairment scale, motor and sensory indices and partial preservation zone (Barbetta et al., 2014). International Classification of Functioning, Disabilities and Handicaps, known more commonly as ICF is constituted in Functional categories based on the their domains. Body functions, physiological functions of body systems; body structures, are anatomical parts of the body such as organs, limbs and their components; activity is the execution of a task or action by an individual and participation is involvement in a life situation; and environmental factors make up the physical, social and attitudinal environment in which people live and conduct their lives. All are evaluated on their qualifiers (Biering-Sørensen et al., 2006; Xiong and Hartley, 2008). Enviro FIM- motor tasksTM a uniform system of measurement for disability based on the International Classification of Impairment, Disabilities and Handicaps. It is contain 18 items composed of 13 motor tasks and 5 cognitive tasks. It uses a seven-step scale anchored by extreme ratings of total dependence as 1 and complete independence as 7 (Daving et al., 2001; Abdul-Sattar, 2014). *Ashwort Scale* Assessment (modification of the *Modified Ashworth Scale – MMAS*) evaluate spasticity testing a muscle that primarily flexes a joint in maximally flexed position and maximal extension over one

second. Score based on the classification following: 0 = No increase in muscle tone; 1 = Slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of the range of motion when the affected part(s) is moved in flexion or extension; 2 = Marked increase in muscle tone, manifested by a catch in the middle range and resistance throughout the remainder of the range of motion, but affected part(s) easily moved; 3 = Considerable increase in muscle tone, passive movement difficult; and 4, maximum value on the scale = Affected part(s) rigid in flexion or extension (Ansari *et al.*, 2008).

Statistic analysis

GraphPad Prism 6.0 software used Statistical analysis after test of Kolmogorov-Smirnov it were used to analyze the normality of the variables studied, treatment was Wilcoxon, Chi-square and Pearson correlation test was applied, considering $p < 0.05$.

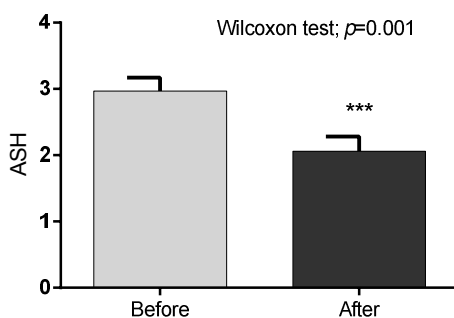
RESULTS

These results present a sample with 50% with spinal cord injury (tetra or paraplegia). Of these, 60% had incomplete injury (ASIA C).

For the initial assessments were applied to *Ashwort Scale Measure*, *Enviro FIM- motor tasks™* and *ICF*. After 10 treatment sessions associated with therapy herbal medicine EOAz the same protocols were performed reviews. In the ICF to start treatment, we evaluated the function according to the construct "b" 26.92% ($p < 0.0001$), the strength and hypertonia of the four members as shown in both, classified as severe were evaluated with statistical significance of 42.86% ($p < 0.0001$) and 57.14% ($p < 0.0001$), respectively. In the body structure "s", the muscles were prevalent in 29%; and their qualifiers classified these muscles strength as moderately severe (55.5%) with partial absence of force (100%) on both sides (88.89%). On "d" performance, the upper limb was evaluated the arm and hand (30%) with moderate disabilities for activity (83.3%) and 66.6% on participation. The most quoted performance in the lower limbs was walking (20%, not significant) severe disability in the activity (50%) and complete participation (50%). And in environmental and personal factors "and" the drug has been recognized (45%) as overall facilitator in 55.56% (Table 1). Spasticity assessment was after 10 sessions of physiotherapy treatment with herbal medicine EOAz. After 10 sessions, spasticity decreased significantly ($p = 0.001$; Figure 2).

Table 1. Frequency of domains and your body function qualifier according to International Classification of Functioning, Disability and Health, patient with central nervous system injury, underwent 10 physiotherapy sessions associated with the herbal medicine EOAz

Domain Function Body "b"		N	%
b7304- Force all members		7	26,92%
b7354- Hypertonic muscles		7	26,92%
Total		26	100%
Force qualifier first of all members (b7304)		Hypertonia qualifier first of all muscles (b7354)	
As gravity	N %	As gravity	N %
3 - Severe	4 57,14***	3 - Severe	3 42,86***
Total	7 100%	Total	7 100%
Structural Domain "s"		N	%
s7702 – muscle		9	29,03***
Total		31	100
Qualifiers	Qualifier first - gravity	Qualifier second– nature of the problem	
	N %	N %	Qualifier third – topographic area
2 - Moderate	3 33	9 100***	N %
3 - Severity	5 55,56**	0	0 0
Total	9 100	9 100	8 88,89***
Domain Performance "d"		N	%
d445 - Use of hand and arm		6	30***
Total		20	100
Qualifier first for activity		Qualifier first for participation	
	N %	N %	
2 - Moderate	5 83,33**	2 - Moderate	4 66,67***
Total	6 100	Total	6 100
Domain environmental factor "e"		N	%
e1101 Drugs		9	45***
Total		20	100
Qualifier first facilitating drugs		N	%
4 - Facilitating total		5	55,56***
Total		5	100



Patients treated with herbal medicine EOAz - 10 sessions

Figure 2. Spasticity (*Ashwort scale* - ASH) assessment before and after in patient with central nervous system injury, underwent 10 physiotherapy sessions associated with the herbal medicine EOAz Wilcoxon test; * $p < 0.05$; ** $p < 0.01$; * $p < 0.001$**

Enviro FIM-motor Task™ also showed significant improvement, increasing their scores (p = 0.001; Figure 3).



Patients treated with herbal medicine EOAZ - 10 sessions

Figure 3. Independence Measure Funcional® instrument (Enviro FIM- motor tasks™) assessment before and after in patient with central nervous system injury, underwent 10 physiotherapy sessions associated with the herbal medicine EOAZ. Wilcoxon test; * p<0.05; ** p<0.01; *** p<0.001

Pearson correlation coefficients showed correlations between the Enviro FIM-motor tasks™ and ICF "b" domain, with r = - 0.63 (moderate) and p = 0.06 after treatment with the herbal medicine EOAZ in 10 sessions (Figure 4).

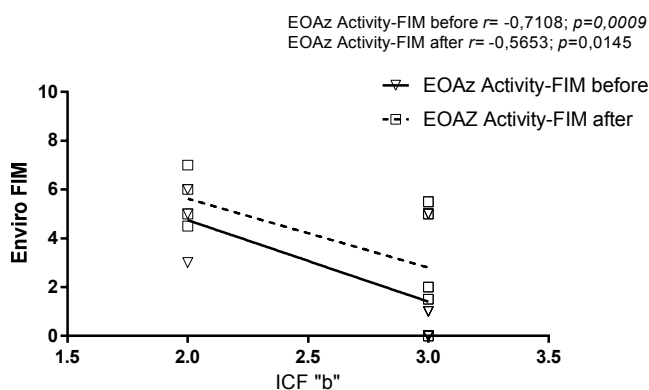


Figure 4. Correlation between Independence Measure Funcional® instrument (Enviro FIM- motor tasks™) and domain function 1 qualifier of the body of the International Classification of Functioning, Disability e Health, patient with central nervous system injury, underwent 10 physiotherapy sessions associated with the herbal medicine EOAZ

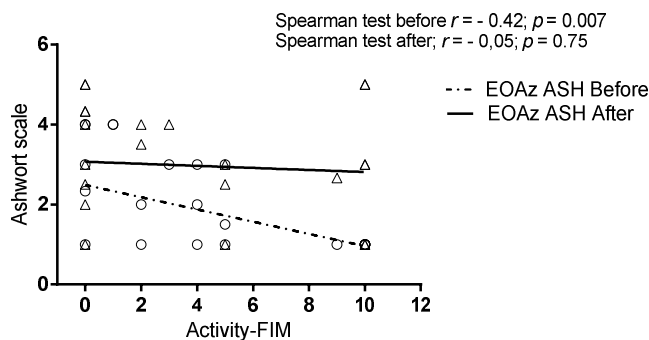


Figure 5: Correlation between spasticity e Independence Measure Funcional® instrument (Enviro FIM- motor tasks™) of patient with central nervous system injury, underwent 10 physiotherapy sessions associated with herbal medicine EOAZ

Although the correlation between spasticity and Activity-FIM before treatment had correlation (r = -0.42; p=0.007), after

treatment had no a correlation with decreased spasticity (r = -0.05; p=0.75) (Figure 5).

DISCUSSION

Our results provide evidence that the motor system provides task-specific and these activities require adequate muscle tonus to be performed. Thus, our results provide evidence that the motor system can improve its performance after muscle tonus improvement. The herbal medicine EOAZ is the basis of OEAZ and study (Santos et al., 2011) demonstrated that this oil is a modulator of L-type voltage Ca²⁺ channel in a dose-dependent manner. Proper modulation for a tonic and phasic tone is crucial to a striated muscle contraction (Beijer et al., 2015). Without this, modulation is linked with the passive tension of titin which influences the basic mechanism of crosslinking of striated muscles (Ottenheijm et al., 2009). The passive elasticity of spastic muscles are superior to the fibers of normal people (World Health Organization, 2013). While the rigidity representing the intrinsic mechanical properties of the muscle fiber and the extracellular matrix throughout the muscle are with fibrous collagen. Altering this disorganization is critical for the proteins carrying passive loads of a muscle in response to spasticity (Teixeira-Salmela et al., 2000; Ottenheijm et al., 2009; Beijer et al., 2015).

Energy availability is important for voluntary muscle contraction in strength training. In this understanding, muscle contraction is dependent on the availability of energy and in cases of damage to the central nervous system this energy is diminished by changes in the mitochondria (Robinson et al., 2013). Also in this study it was seen that differences in the distribution of presynaptic mitochondria and the conformation of post synaptic folds suggest dysmorphism in the Cerebral Palsy group at the level of postsynaptic folding and presynaptic organelle distribution. Previous studies (Teixeira et al., 1998; Teixeira-Salmela et al., 2000) report a correlation between the degree of spasticity with the ability function and second study (Dietz and Sinkjaer, 2007) is necessary to reduce spasticity for kinesiotherapy enable strength of these muscles and that proper recruitment needs L-type voltage Ca²⁺ channel regulation (Cândido and Xavier-Filho, 2012; Maia et al., 2016). Cândido and Xavier-Filho (2012) also showed better kinesiotherapy in children whose treatment was associated with OEAZ in a month of treatment. And complemented by research (Maia et al., 2016) where patients with spasticity showed better muscle recruitment, assessed by electromyography, after an hour of using OEAZ.

Conclusion

It was possible to verify that herbal medicine EOAZ with physiotherapy contributed for the increase of individual functionality with sequels due of the Pyramidal Syndrome commitment. Patients treated with herbal medicine EOAZ were classified as functionally tetraparetic moderate spastic with moderate disability in activity and participation in hand and arm and serious and full commitment on the floor. This profile shows lower gravity of the body function, according to the ICF is the lowest Enviro FIM- motor tasks™; Regarding spasticity after treatment with herbal medicine EOAZ, there was no correlation after the treatment indicating that this drug helps to improve spasticity.

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Conflicts of Interest: There are no conflicts of interest to be declared.

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