Article

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Validation of the Santa Casa Evaluation of Spasticity Scale

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ABSTRACT

Spasticity is a clinical condition that has negative repercussions on function. A scale capable of quantifying the severity and impact of an injury is fundamental to the rehabilitation process. The objective of this study was to retest and validate the Santa Casa evaluation of spasticity scale, a descriptive assessment of activities of daily living, transfers and locomotion. We analyzed spasticity and functional status in 97 hemiparetic patients. With statistical significance ($p<0.05$), this new scale demonstrated reliability in assessing clinical-functional conditions and reproducibility as a daily assessment scale for use during rehabilitation.

Key words: muscle spasticity, disability evaluation, validation studies.

Validação da Escala de Avaliação da Espasticidade Santa Casa

RESUMO

A espasticidade é uma condição clínica que pode repercutir negativamente na condição funcional. Um instrumento de avaliação capaz de mensurar a gravidade e a conseqüência da lesão torna-se ferramenta fundamental ao processo de reabilitação. O objetivo foi reproduzir e validar a Escala de Avaliação da Espasticidade Santa Casa (EAESC), instrumento descritivo correspondente às atividades de vida diária, transferências e locomoção. Analisou-se a espasticidade e condição funcional de 97 pacientes hemiparéticos. Com significância estatística ($p<0,05$), a EAESC mostrou-se sensível à análise das condições clínico-funcionais, sendo hábil sua reprodutibilidade como instrumento rotineiro de avaliação à reabilitação.

Palavras-chave: espasticidade muscular, avaliação da deficiência, estudos de validação.

Several clinical conditions can cause damage to the central nervous system (CNS). Such conditions include craniocerebral trauma, tumour cerebral, cerebrovascular accident (CVA), spinal cord, cerebral palsy and multiple sclerosis, all of which commonly result in spasticity[1-3].

Spasticity is the most common nonfunctional disorder in congenital or acquired injury to the CNS, which affects millions of individuals worldwide[1,4-7].

Spasticity is defined as a velocity-dependent increase in the resistance of muscles to passive movement, as well as by muscle weakness, pronounced hyperreflexia, abnormal cutaneous and autonomic reflexes with the Babinski sign, caused by lesion of the upper motor neuron involving the cortico-reticulo-bulbo-spinal pathway[4,7-14]. Since it affects the musculoskeletal system, the consequences of spasticity has a direct effect, albeit in varying degrees of severity, on the lives of patients, impairing their ability to carry out activities of daily living, as well as causing pain, contractions and deformities, all of which hinder the rehabilitation process[15-19]. Functional activity, or functionality, is defined as the ability to carry out activities of daily living such as feeding oneself, remaining

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mobile, making transfers, maintaining personal hygiene and locomoting[20]. The Ashworth scale, created by Bryan Ashworth in 1964[21], and the modified Ashworth scale (MAS), devised by Bohannon and Smith in 1987, are simple instruments employed to quantify muscle resistance to passive movement, the latter being more sensitive[22,23]. One instrument used in evaluating and quantifying incapacity is the Functional Independence Measure (FIM), a scale created for use in the United States and validated for use in Brazil[24,25]. In 1990, Lianza et al. created the Santa Casa scale[26], an instrument designed to measure the degree of spasticity and determine its repercussions on functional performance. Although easily applied, the scale presented little sensitivity.

Spasticity and its consequences constitute a great challenge, for patients as well as for physical therapists. Therefore, it is fundamental to have, at the outset of the rehabilitation process, an instrument that quantifies the degree of spasticity and its impact on function. In view of this, we have modified the Santa Casa scale, using the new name Santa Casa evaluation of spasticity scale (SCESS) to designate the modified version.

The objective of the present study was to test and validate the SCESS.

METHOD

The study sample consisted of 97 hemiparetic patients with spasticity treated in the Rehabilitation Sector of the Santa Casa de Misericórdia de São Paulo, Brazil.

The following inclusion criteria were applied: being at least 14 years of age; having received a clinical diagnosis related to acquired brain injury, such as CVA, cerebral tumour, craniocerebral trauma or multiple sclerosis; presenting proportionate or disproportionate topographic distribution of hemiparetics; being treated in the Rehabilitation Sector of the Santa Casa Sisters of Mercy Hospital of São Paulo; and having given written informed consent.

We excluded patients who had been submitted to selective chemical neurolysis, such as botulinum toxin type A or phenol, within the preceding six months, as well as those who were wheelchair-bound, those treated with antispasticity agents and those with severe cognitive deficits.

The study design was approved by the Ethics in Research Committee of the Hospital. Subsequently (from April to November of 2007), data were collected by two evaluators (raters). The raters had been previously trained in an attempt to increase the degree of inter-rater concordance in relation to the scales and their respective applications.

The specific instruments employed in the collection of data were the MAS, the FIM and the SCESS.

The MAS is used in order to classify muscle tone, which is scored from 0 to 4 based on the resistance to passive movement[22]. The muscle groups evaluated were the elbow flexors and the knee extensors.

The FIM is an 18-item scale that quantifies incapacity based on six functional conditions (self-care, sphincter control, mobility, locomotion, communication and social cognition), the score ranging from 18 to 126 points[25]. In the present study, this scale was used as a self-report questionnaire and could therefore be referred to as an oral FIM.

The SCESS is designed to quantify the impact that spasticity has on functional status in terms of the performance of activities of daily living and transfers, as well as locomotion, the score ranging from 1 to 5.

The SCESS is a modified version of the Santa Casa scale. The alterations to the Santa Casa scale were made after discussions between the researchers and the principal author of the scale. The resulting modified version (the SCESS) was applied in the evaluation of the patients in the current sample.

To determine the reliability of the SCESS, an initial evaluation (test) was followed by a second evaluation (retest) one week later, both evaluations being performed by the same observer (rater) and inter-rater reliability being determined. The MAS and the FIM were applied, together with the SCESS, only in the initial evaluation. The MAS and the FIM were used in order to draw correlations between their efficiency and that of the scale put forth for validation (the SCESS). The SCESS was used in order to evaluate muscle tone and functional status based on the performance of certain activities, which were divided into two categories: upper limbs– including activities of daily living (feeding oneself, dressing, donning clothing accessories and maintaining personal hygiene) and practical activities (writing, operating household appliances and using home electronics); and lower limbs – the capacity to walk a certain distance with or without the aid of a parallel bar.

Analysis of variance was observed in the association between the scale and aspects such as age, genre, type of injury and topography. Evaluation of reliability (internal consistency and stability) was tested by analyzing the coefficient of reliability, with the model test-retest, and the value of Cronbach alpha. The validation was established by the linear correlation between the results for each area and results in the measures chosen as the gold standard for that area measured by Pearson correlation coefficient. The statistical significance used was $p<0.05$.

RESULTS

In the present study, 97 patients were evaluated. The sociodemographic data are shown in Table 1.

Table 2 shows the associations between the SCESS score and the variables age, gender, duration of injury and topographic diagnosis.

In terms of the ability to evaluate the upper limbs, the correlations between the SCESS and the MAS and the FIM are shown in Table 3.

Table 4 shows how the SCESS correlates with the MAS and the FIM, in terms of the ability to evaluate the lower limbs.

Data related to the test-retest (inter-rater) reliability of the SCESS are shown in Table 5.

Table 1. Characteristics of the patients (n=97) by analysis of variance.

Age (years)	
Mean±SD	52.10±15.362
Gender, n (%)	
Male	59 (60.8)
Female	38 (39.2)
Duration of injury (months)	
Mean±SD	45.22±52.697
Clinical diagnosis, n (%)	
Cerebrovascular accident	86 (88.7)
Other	11 (11.3)
Topographic diagnosis, n (%)	
Left-hemisphere paresis	47 (48.5)
Right-hemisphere paresis	50 (51.5)

SD: standard deviation.

Table 2. Associations between the variables and the scale by analysis of variance.

	SCESS*
Age	p<0.095
Gender	p<0.580
Duration of injury	p<0.651
Topographic diagnosis	p<0.434

SCESS: Santa Casa Evaluation of Spasticity Scale; *level of statistical significance, p<0.05

DISCUSSION

Injury to the CNS that involves the cortico-reticulo-bulbo-spinal pathway results in altered muscle tone and reduced activity of the musculoskeletal system, which has repercussions for functional capacity[5,13-17].

The leading cause of neurological dysfunction in the adult population is CVA[27], which results in a number of incapacitating conditions. One such condition is spasticity, which should be appropriately evaluated in order improve the functional prognosis for CVA patients[20]. In the present study, CVA was the most prevalent etiology, being seen in 88.7% of the patients.

The relationship between age and the functional prognosis remains unclear, although there are data indicating that the prognosis is worse for older patients[20]. In our study, as in those conducted by Rankin, by Bruell and Simon and by Caroll[28-30], no association was found between age and functional prognosis.

We found no significant association between gender and functional capacity, which is in agreement with the findings of Bourestom, of Adams and Merrett and of Kaste and Waltimo[31-33].

Among patients in a rehabilitation program, Anderson et al. studied factors considered determinants of functional gains[34]. The authors found no significant association between the duration of injury and current functional status. Their results are in keeping with those obtained in the present study.

Another variable that might be predictive of functional status is the topography of the lesion (cerebral hemisphere affected). This was not found to be the case in

Table 3. Interscale correlations related to the upper limbs Pearson's correlation.

		SCESS*				
		100% capable	75% capable	50% capable	25% capable	<25% capable
MAS	0					
	1	0.05*	0.32			0.97
	1+	0.48	0.06	0.08		
	2			0.05*	0.10	0.19
	3				0.13	0.16
	4					
FIM	Independence/ Modified independence	0.16	0.05*	0.48		0.97
	Minimal supervision/ dependence		0.10	0.05*	0.24	
	Moderate dependence			0.48	0.05*	0.32
	Maximum/total dependence				0.32	0.05*

SCESS: Santa Casa Evaluation of Spasticity Scale; MAS: Modified Ashworth scale; FIM: functional independence measure; *level of statistical significance, p<0.05.

Table 4. Interscale correlations related to the lower limbs Pearson's correlation.

		SCESS*				
		100% capable	75% capable	50% capable	25% capable	<25% capable
MAS	0					
	1	0.05*	0.19			0.48
	1+	0.19	0.06	0.16	0.97	0.97
	2	0.24	0.10	0.08	0.19	0.19
	3			0.48	0.19	0.32
	4					
FIM	Independence/ Modified independence	0.04*	0.09			
	Minimal supervision/ dependence		0.05*	0.05*		
	Moderate dependence			0.13	0.05*	
	Maximum/total dependence				0.08	0.05*

SCESS: Santa Casa Evaluation of Spasticity Scale; MAS: Modified Ashworth scale; FIM: functional independence measure; *level of statistical significance, p<0.05.

Table 5. Inter-rater reliability of the SCESS.

	SCESS – test									
	100% capable		75% capable		50% capable		25% capable		<25% capable	
	UL	LL	UL	LL	UL	LL	UL	LL	UL	LL
SCESS – retest										
100% capable	0.06	0.05*			0.97					
75% capable	0.97		0.05*	0.02*	0.97	0.485		0.97		
50% capable			0.97		0.05*	0.05*				
25% capable							0.04*	0.06		
<25% capable									0.04*	0.05*

SCESS: Santa Casa Evaluation of Spasticity Scale; UL: upper limbs; LL: lower limbs; *level of statistical significance, p<0.05.

studies conducted by Adams and Merrett, by Andersen et al. and by Mills and DiGenio[32,35,36]. However, Denes et al. found that individuals with left-hemisphere CVA presented significantly better functional capacity than did those with right-hemisphere CVA[37].

The MAS is a rapid and easily applied means of quantifying spasticity, and it is therefore widely used in clinical practice[38]. Nakhostin-Ansari et al. compared the original Ashworth scale and the MAS in terms of inter-rater reliability[39]. The authors found that both scales presented low inter-rater reliability in tests of the elbow flexor muscles (61.6% for the Ashworth scale and 53.9% for the MAS). Mehrholz et al. also demonstrated the limitation of the two scales in terms of inter-rater reliability in measurements of upper-limb spasticity[40]. Hass et al. obtained similar results in relation to the lower limbs and demonstrated that the original Ashworth scale presented better reliability for this parameter[41].

Recent neurophysiological and biomechanical studies, conducted by Pandyan et al.[42] and by Morris[43], respectively, have called into question the use of the MAS as the gold standard for evaluating spasticity in clinical practice and in research[42,43]. According to Pandyan et al., the reduced reliability of the MAS is due to the items '1', '1+' and '2', since the extra classification ('1+') increases the probability of error[42]. However, Bohannon and Smith, the creators of the scale, found that concordance was high when the MAS was applied. Nakhostin-Ansari et al. stated that, in order to achieve such concordance, it is necessary to have training in the use of the MAS, as well as experience and interaction with the scale[39].

In the present study, none of the patients received an MAS score of 0 or 4, which would indicate normal or rigid muscle tone, respectively, since such patients would have been excluded from the analysis for not presenting spasticity or for being completely immobilized.

In correlating the MAS with the SCESS (Tables 3 and 4), we found no significance, suggesting that the degree of spasticity does not necessarily predict functional status. We found that patients with lower MAS scores did not always present 100% capacity to perform the activities evaluated. The MAS assesses only the passive resistance movement to fast muscle, unlike the SCESS which measures the spastic condition of the functional condition. Therefore, a low or no resistance to the muscle during passive motion assessment with MAS may also mean a plegia thus a condition unfavorable to the SCESS features.

Certain aspects evaluated in the FIM, such as sphincter control, communication and social cognition, were unaffected by the degree of spasticity, which, in our opinion, indicates that the SCESS presents low sensitivity.

The SCESS is a scale that is applied by observing the performance of activities of daily living and locomotion. Therefore, it is more specific than is the FIM for activities that are affected by spasticity (Table 3). In Table 4, which presents data on functional status of the lower limbs, the results cited above can be seen.

There was a statistically significant correlation between the FIM and the SCESS, despite the different strategies used in their application. This is likely due to the influence that motor and musculoskeletal aspects have on communication skills, social cognition and sphincter control, although further studies should be conducted in order to increase knowledge of these variables that are so important to the rehabilitation process.

Table 3 shows that there were some patients who presented total independence in the self-care domain of the FIM and yet were found to have <25% capacity according to the SCESS. This finding is attributable to the strategies employed by the patients in performing the proposed activities. In the case of the FIM, the patients simply reported on the manner in which they performed those activities, whereas, for the SCESS, they were instructed to actually extend the limb in order to allow the evaluation of the degree to which spasticity impaired the function. In fact, the patients presented independence in their performance of those activities but only by compensating (not fully extending the elbow).

According to Dombovy, the recovery of motor function in terms of time and quality is better in the lower limbs than in the upper limbs[44]. This can be explained by the fact that the cortical representation of the body segments necessary for fine motor skills is greater than that of those necessary for gross motor skills[45].

The upper limbs require preserved sensory, proprioceptive and cortical responses in order to maintain their motor function, which is related to proprioception and to the quality of coordination, with the objective of providing fine motor control. The lower limbs, responsible for gross motor functions such as weight support and locomotion, present fewer cortical connections, which would imply better recovery of motor skills[46-48].

As can be seen in Table 5, the test-retest (inter-rater) reliability of the SCESS was high for certain items, with a trend toward statistical significance for the remaining items, thereby indicating the sensitivity of the scale. This is of great importance when the principal objective is clinical follow-up evaluation, since it makes it possible to determine the quality of the rehabilitation program, as well as that of the treatment facility itself[25]. In this case, factors such as age, gender, topography and time of injury become important for monitoring and directing the process of rehabilitation.

It is common for instruments designed to quantify physical incapacity to be used in place of those that specifically evaluate muscle strength, muscle tone and range of movement in order to determine the degree to which the upper and lower limbs are impaired, the former type of instrument often lacking sensitivity[48]. That is what prompted us to modify the original Santa Casa scale. Since they perform different functions and are applied in different skills, we evaluated the upper and lower limbs separately, which is important to assessing the true status of the patients. The SCESS presented good sensitivity for this purpose.

There is no instrument designed to determine the influence that spasticity has of functional capacity, and there is therefore no gold standard with which to draw comparisons, a difficulty also encountered by Riberto et al. in validating the FIM[25]. Therefore, we used scales that are similar to the one proposed so that the results would also be similar, in order to determine the interscale concordance, characterizing and contributing to the convergent validation, in which the deficiency presented would promote incapacity that is proportional to the clinical and functional status of the patient.

In conclusion, the results of the present study show that the SCESS has good sensitivity and reproducibility in determining the impact that spasticity has on the functional status of CVA patients in rehabilitation.

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