Validation of visual instrument for location and measurement of pain intensity

Validação de instrumento visual para localização e mensuração da intensidade da dor

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ABSTRACT

BACKGROUND AND OBJECTIVES: There are very few instruments in the literature that allow for the precise identification of neuropathic pain, that are easy to apply and can represent the pain intensity and location within the plexus path, as well as be used for pain management. The objective of this study was to validate a visual instrument made from a color scale and a body diagram to locate and measure the pain intensity in adults with brachial plexopathy.

METHODS: This exploratory study used a quantitative approach. The sample was composed of 35 patients presenting brachial plexus pain and who underwent surgery. The instrument is composed of a four-color scale and a body diagram. Each patient identified a color on the scale for each pain intensity and then colored the representative pain area in the diagram using one or more colors. Criterion validation was used to prove the correlation between the scores obtained by the instrument and the surgical reports, which were used as the external criterion.

RESULTS: A significant agreement was observed between the representation of pain in the diagram and the surgical report in all nerve trunks.

CONCLUSION: The instrument was found to be useful for locating the pain and measuring its intensity in patients with brachial plexopathy.

Keywords: Anatomy regional, Brachial plexus, Pain, Pain measurement, Validation study.

RESUMO

JUSTIFICATIVA E OBJETIVOS: Na literatura são escassos os instrumentos que permitem identificar precisamente a dor neuropática, sejam de fácil aplicação, possam representar a intensidade e a localização da dor dentro do trajeto plexular e ser utilizados no manejo da dor. O objetivo deste estudo foi validar um instrumento visual composto por escala de cores e diagrama corporal para localização e mensuração da intensidade da dor em adultos com plexopatia braquial.

MÉTODOS: Estudo exploratório, com abordagem quantitativa. A amostra foi composta por 35 pacientes com plexobraquialgia submetidos a tratamento cirúrgico. Foi utilizado um instrumento imagético composto por uma escala de quatro cores e um diagrama corporal. Os pacientes identificaram na escala uma cor para cada intensidade de dor e coloriram no diagrama a sua área representativa, utilizando uma ou mais cores. A validação de critério foi utilizada para comprovar a correlação entre os escores do instrumento criado e os laudos cirúrgicos que corresponderam ao critério externo.

RESULTADOS: Observou-se concordância significativa entre a representação da dor no diagrama corporal e o laudo cirúrgico em todos os troncos nervosos.

CONCLUSÃO: O instrumento imagético se mostrou útil para localização e mensuração da intensidade da dor em pacientes com plexopatia braquial.

Descritores: Anatomia regional, Dor, Estudo de validação, Medição da dor, Plexo braquial.

INTRODUCTION

The epidemiology of the traumatic injury of the brachial plexus in 90% of the cases is related to young males that get involved in automotive accidents, with traction mechanisms between the cervical area and the shoulder[1]. It's a multifactorial problem with a relevant prevalence, in which the neurological dysfunction, potentially accompanied by sequela, is one of the consequences[1].

The injury of the brachial plexus brings an important social impact, with an incidence of 1.3% in poly traumatized patients and of 5% in victims of motorcycle acidents[2].

One of the difficulties in addressing the brachial plexus pain is the diagnosis and systematization for follow-up and management[2]. Methods of pain assessment are scarce; indirect assessments such as self-reports and behavioral measures are

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often performed. There is a lack of systematization and quantification of various methods[3].

The methods for pain assessment can be classified into uni and multidimensional. The unidimensional ones allow to evaluate only one dimension of pain, which is, in general, the intensity. The visual numeric scale (VNS), verbal rating scale (VRS), face pain scale (FPS) and color analog scale (CAS)[4] stand out.

A scale that precisely identifies intensity, location and path of pain is non-existent in the literature. Thus, there is a gap in the literature in regard to an instrument that allows for the precise identification of pain in the brachial plexopathy, which is also easy to apply, that could represent intensity and location within the plexular path and that could be used in the clinical handling of these patients.

In that sense, this study aimed at validating an image instrument composed of color scales and a body diagram for the location and measurement of pain intensity in adults with brachial plexopathy.

METHODS

Exploratory study, quantitative approach, and diagnostic accuracy. The investigation was developed in the outpatient clinics of two large institutions which perform medium and high complexity care in Belo Horizonte, Minas Gerais. The collection of data was made in the period from December 2011 to December 2012.

Thirty patients with injury in the brachial plexus attended the institution A, of which 24 presented pain. Twenty-three patients were attended at the institution B and all presented pain. The 47 patients participated in the first stage of this study, in which the color scale for the measurement of pain intensity was validated.

In the next stage, the sample consisted of 35 patients with plexobrachialgia that were submitted to surgical treatment.

The established inclusion criteria were for adult patients with preserved cognition, good graphic recording conditions and recognition of the corresponding presented color, to avoid bias of color blindness and agreement to participate in the study. The exclusion criteria were patients under 18 years of age. All patients were from the *Sistema Único de Saúde* (SUS).

At first, the data collection was performed, characterizing the studied population, as well as the completion of body diagrams to locate pain. At the same time, a color scale was validated and built with the general population. This step was performed in the outpatient clinics of both institutions and 47 patients with plexobrachialgia participated.

In the end, the gathered information was used to verify the psychometric properties, reliability, and validity of the instrument. The statistical analyses of the data were also performed to validate the instrument[5].

In the data collection for validation of the color scale, patients were presented with four colored pencils: black, yellow, red and orange; as well as a scale with four levels of pain intensity: weak, moderate, intense and worst pain imaginable/unbearable. Each patient was asked to associate the colors to the levels of pain intensity and to color, according to their perception, each level of the scale with one color.

In order to locate the pain on the body diagram, the patient was asked to evaluate the intensity of their pain, to choose the corresponding pencil(s) and to color the area that portrayed the location of their pain in the body diagram.

The time needed for the patients to color the corresponding area(s) of the location of their pain was approximately 10 minutes.

The validation of the color scale was done through descriptive analysis, using simple frequency distribution.

To determine the reliability of the pain representation in the diagrams, the researcher analyzed each representation, correlating the colored area(s) with the dermatomes, and registered in a chart the corresponding nerve trunk. For determining the reliability of this evaluation, it was submitted to three specialist doctors who acted as expert consultants.

The validity of criteria was chosen to validate the instrument regarding the location of pain. This is a "gold standard" method to prove the correlation between the scores of the instrument to be tested and some external criteria to be taken as standard, in this case, with surgical reports. It should be noted that this standard was chosen to serve as a reference for the analysis of the sites of pain representation in the body diagram and not to diagnose the injured nerve trunk(s).

The study was approved by the Research Ethics Committee of the *Universidade Federal de Minas Gerais* (ETIC 22/10), as recommended by the National Health Council. After explaining the objectives of the study, the participants signed the Free and Informed Consent Term (FICT).

Statistical analysis

The Kappa Coefficient was used to verify the existence and intensity of agreement between the representation in the body diagram and the surgical reports for each upper, middle and lower nerve trunk, as well as for all trunks[5]. Performance measures such as sensitivity and specificity were also accounted for.

RESULTS

In this stage of validation of the body diagram for pain location, 35 patients with plexobrachialgia who underwent surgical treatment participated. The mean age of the participants was 34.4 years, ranging from 18 to 70 years. The predominance was for males (91.5%) and incomplete primary education (47.8%). Most of the patients (55,3%) were from small towns of Minas Gerais and the rest were from Belo Horizonte (BH) or the metropolitan area of Belo Horizonte. The type of work varied greatly, but the predominance was for manual labor (43,5%).

During the validation process of the color scale, only one patient did not color the space representing the label of strong pain and used red to represent the worst pain imaginable. The rate of agreement between the patients (98.9%) was very high. On the color scale for the pain intensity representation, yellow

was chosen to represent weak pain, orange for moderate pain, red for strong pain and black for the worst pain imaginable.

Still for the validation of the color scale, regarding reliability, each expert evaluated 47 body diagrams. Two experts fully agreed with all the evaluations made by the researcher and one expert partially agreed with two evaluations and fully agreed with the rest (45). Therefore, out of a total of 141 evaluations, there was agreement in 139, obtaining a reliability index of 98.6%, above the level of 70 to 80%, recommended as acceptable[5].

Regarding the validation of the body diagram for pain location, the existence and intensity of agreement between the representation in the body diagram made by patients and the surgical reports was verified. Performance measures, such as sensitivity and specificity (Table 1), were also accounted for.

In the upper trunk the specificity was 85.7%, sensitivity 50% and the positive predictive value (PPV) 70%; in the middle trunk the specificity reached 96.1%, sensitivity 10% and PPV 50%; in the lower trunk the specificity was 93.8%, sensitivity 33.3% and PPV 33.3%. Finally, for all trunks, the specificity reached 47.1%, sensitivity 88.9% and PPV 64%.

For the upper and middle trunk, the agreement was substantial. The agreement was excellent in the lower trunk and for all trunks the agreement was medium.

Table 1. Contingency and Kappa coefficient between test and diagnosis for each nerve trunk

	Surgical report		Total n (%)	Kappa	p-value
	No n (%)	Yes n (%)			
Upper trunk Body diagram					
No	18 (85.7)	7 (50.0)	25 (71.4)	0.6774	<0.001
Yes	3 (14.3)	7 (50.0)	10 (28.6)		
Total	21 (100.0)	14 (100.0)	35 (100.0)		
Middle trunk Body diagram					
No	24 (96.0)	9 (90.0)	33 (94.3)	0.709	<0.001
Yes	1 (4.0)	1 (10.0)	2 (5.7)		
Total	25 (100.0)	10 (100.0)	35 (100.0)		
Lower trunk Body diagram					
No	30 (93.8)	2 (66.7)	32 (91.4)	0.8848	<0.001
Yes	2 (6.3)	1 (33.3)	3 (8.6)		
Total	32 (100.0)	3 (100.0)	35 (100.0)		
All trunks Body diagram					
No	8 (47.1)	2 (11.1)	10 (28.6)	0.503	<0.001
Yes	9 (52.9)	16 (88.9)	25 (71.4)		
Total	17 (100.0)	18 (100.0)	35 (100.0)		

Regarding the distribution of pain locations in the body diagram, it was noted that the majority (85.1%) of patients located pain in more than one area of the upper limb, but in all representations the extremity of the limb was included, as can be seen in figures 1, 2 and 3.

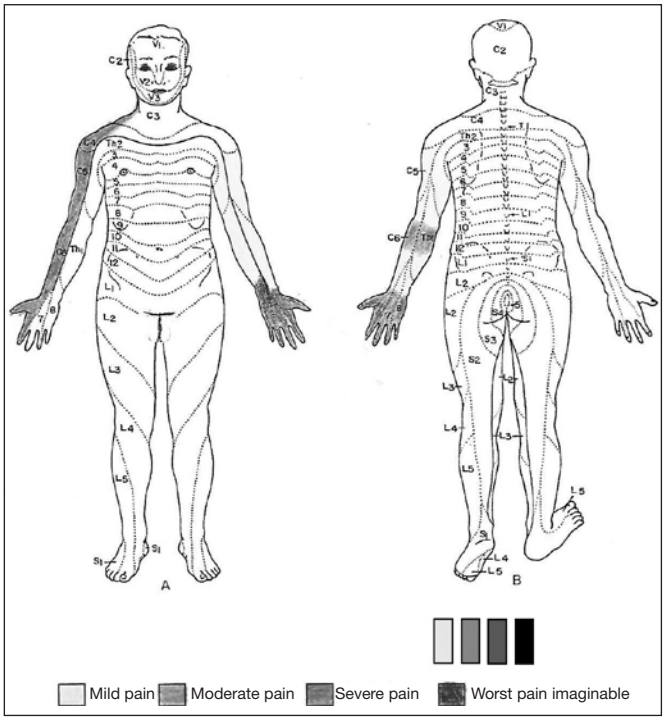

Figure 1. Pain intensity scale

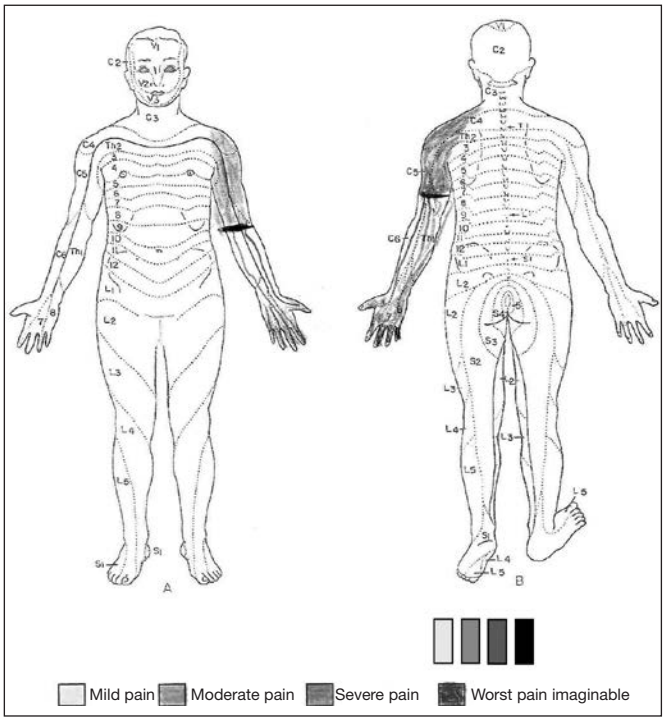

Figure 2. Pain intensity scale

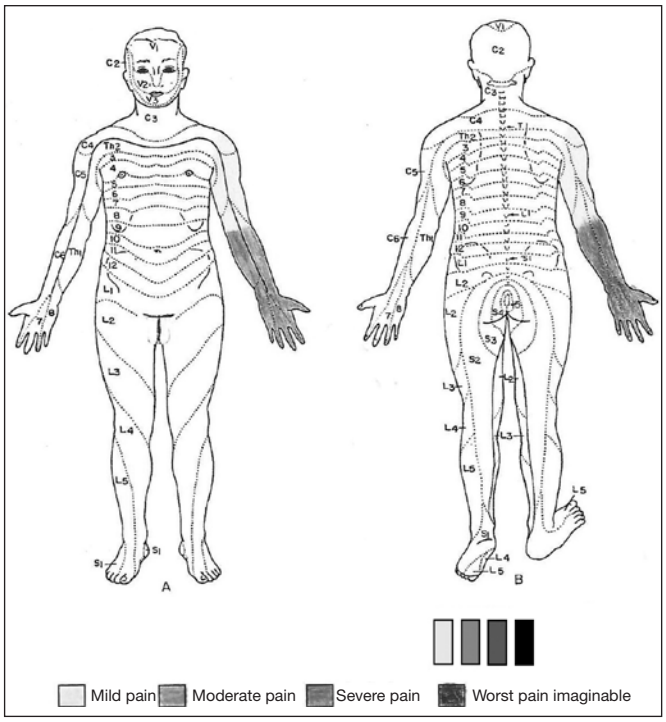

Figure 3. Pain intensity scale

DISCUSSION

The brachial plexus injuries result from traction mechanisms or direct trauma and generally cause limitations that can be severe, with socioeconomic repercussions for the individual and the health system[2,6].

In addition to the limitations imposed by the neurological deficit itself, most of these patients experience refractory pain which is difficult to manage, accompanied by worsening of the dysfunction imposed by the traumatic brachial plexopathy[7]. Therefore, the correct evaluation in body diagrams and the pain management of these patients are necessary to complement the motor and sensitive neurological evaluation.

To identify the location of pain, the body diagrams in which the patient shows or marks the area(s) of pain is reccomended[8-11]. However, this type of registry does not encompass the extension of pain because the pain is resulting from an injury in the peripheral nerves, as is the case with the brachial plexus, in which pain is diffuse, irradiated and schoking[12,13].

The instrument that was built works allowing the patient to locate, measure the intensity and represent the precise extension of their pain in the body diagram, as well as the health professional to correlate the pain to the severity of brachial plexus injury.

The specificity index that was reached was high for the upper, middle and lower trunks and moderate for all nerve trunks. These results show that the identification of pain in the body diagram is highly associated with the presence of injury, i.e., in the areas of the body diagram where no representation of pain was made, there was also no detection of injury of the corresponding nerve trunk.

It is also important to note that in the cases of trauma in the brachial plexus there may be microlesions that are not detected in surgeries. This fact may have contributed to the low sensitivity of the instrument, i.e., the patient's registry of more areas of pain than the lesions detected by neurological examination.

The image instrument allowed, thus, for a simple and objective evaluation of the patient's pain. In addition to that, a correlation between the pain intensity and the severity of the injury, not yet described in the literature, was observed. These characteristics can help the initial assessment and potentially be a tool for long-term follow-up and pain management of these patients, optimizing the treatment of pain that is often not satisfactorily addressed.

It's accepted as a study limitation the absence of a gold standard exam that could be used as an external criterion for validating the instrument, which had an impact on the sample size. Finally, the objective of the study was achieved, that is, offering healthcare professionals an instrument for assessing pain in adults with brachial plexopathy that is easy and fast to apply and that characterizes pain in regard to intensity, location, and extension within a plexular path.

CONCLUSION

The image instrument proved to be a useful tool for locating and measuring the intensity of pain in patients with brachial plexopathy.

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