Research Article

iMedPub Journals
http://www.imedpub.com

JOURNAL OF NEUROLOGY AND NEUROSCIENCE
ISSN 2171-6625

2016
Vol. 7 S3: 124

DOI: 10.21767/2171-6625.1000124

Use of Bells Test in the Evaluation of the Hemineglect Post Unilateral Stroke

Oliveira de CR[1,2], Luara de FC[1], Karina CP[3] and Rochele PF[1]

1 Psychology Faculty, Pontifical Catholic University of Rio Grande do Sul, Porto Alegre, Brazil
2 Psychology Faculty, Passo Fundo, Brazil
3 Speech and Language Department, Federal University of Santa Maria, Santa Maria, Brazil

Corresponding author:
Karina Carlesso Pagliarin

karinap_fono@yahoo.com.br

Speech and Language Department, Federal University of Santa Maria, Santa Maria, Brazil.

Tel: (+5555) 84036564

Citation: Oliveira de CR, Luara de FC, Karina CP, et al. Use of Bells Test in the Evaluation of the Hemineglect Post Unilateral Stroke. J Neurol Neurosci. 2016, 7: S3.

Abstract

The Bells Test is a cancellation task with distractors that requires visual exploration. It can evaluate visual hemineglect. The aim of this study was to compare performance between groups (right brain damage, left brain damage and healthy controls) in the Bells Test, as well as to evaluate and characterize the evaluation of hemineglect through this instrument. Forty-six stroke patients and 46 healthy controls were evaluated with Bells Test. In general patients with right brain damage had more omissions than those with left brain damage and healthy controls in left ($p = 0.06$) and right columns ($p = 0.06$), and total of omissions ($p = 0.02$). They also took longer to complete (showed a long time to perform) the task ($p \leq 0.001$). In addition, we identified 22% of the right brain damage sample with signs of hemineglect, greater prevalence of disorganized strategies and a cancellation starting pattern more to the right field. The Bells Test showed significant applicability to differentiate the groups.

Keywords: Neuropsychology; Attention; Stroke; Evaluation; Hemineglect

Received: May 06, 2016; **Accepted:** June 06, 2016; **Published:** June 10, 2016

Introduction

Hemineglect (HN), unilateral HN or hemi-inattention is a complex set of symptoms in which the patient ignores or does not respond to stimuli contralateral to the brain lesion [1]. HN occurs frequently in patients who suffered unilateral stroke, being more prevalent in individuals with right brain damage (RBD) [2,3]. It is well known that right hemisphere is widely considered as dominant to spatial selective attention, orientation. Inferior parietal lobule, superior temporal cortex and inferior frontal gyrus are regions most frequently lesioned in neglect patients [4]. The right hemisphere distributes attention evenly in the both sides of the extra-personal space [5]. The incidence of HN ranges from 10 to 82% of the RBD patients and from 15 to 65% in patients with left brain damage (LBD) [2,6,7].

Many different subtypes of HN were reported, and they can occur in different forms such as visual-spatial, tactile and auditory. The most common pattern of HN in chronic patients is neglect of space near the body (peripersonal) and occurs in approximately 30% of the adults with RBD. Another common pattern is the association between peripersonal and personal HN. There are also dissociations between motor HN (difficulty concerning direction towards the left side of the body) and attention-perception HN (failure to perceive objects and events in the contralesional side) [8]. Besides the comorbidities of the different types of HN, other sequelae can be related to the HN syndrome, such as anosognosia (being uncapable of recognizing his/her own disease). The components of these symptoms can be associated and dissociated in different ways [9].

HN can be classified as mild, moderate or severe. The level of impairment is classified based on the patient performance on the standard battery [10]. The detection of mild HN is more complicated than severe HN. In such cases, combining different tests in which quality (coverage of all significant forms of HN) and quantity (not tiresome for the patients to undergo and cost effective to the health center), can be a challenge for researchers regarding the selection of the appropriate instruments [9].

In view of the complexity of HN manifestations and its association with a worse prognosis of functional recovery and difficulties in daily activities [11], its diagnosis based on performance instruments has been the subject of many studies. Several tools were developed for the assessment of HN over the past decade. Most are pencil and paper tasks that assess the performance related to the peripersonal space. Tasks such as line bisection

© Under License of Creative Commons Attribution 3.0 License

(participants are required to bisect a number of lines in half with varying lengths), figure copying (participants are required to copy some figures as square, cube, flower) and cancellation tasks, generally with distractors (participants are required to cross out all the targets, for example, bells), are used to detect and quantify the symptoms of visual-spatial and peripersonal HN. One of the most traditional instruments used for the assessment of this type of HN is line crossing developed by Albert in 1973 [12], Albert's Test. In this test, patients must cross out lines that are placed in random orientations on a piece of paper; however, this test does not detect mild cases of HN because of the lack of distractors.

Some authors claim that a single test may not be sensitive to a particular type of HN in a given patient, since the instrument selected may not assess the impaired modality, contributing to the occurrence of false negative results [13]. Thus, a complete neuropsychological assessment should involve tasks for indirect investigation of HN such as language (reading and writing subtests), mathematics and praxis (figure copying) and behavioral observation. Therefore, although these tests are not specific for HN assessment, the specialist can make inferences on the syndrome throughout the neurocognitive diagnosis process.

Nevertheless, the routine in medical offices, outpatient units and bedside assessments make it impossible to perform several tasks to assess the same function. Thus, the Bells Test (BT) in which the cancellation paradigm was developed for assessment of HN, inspired in the same principles of Albert's Test was developed. This is the most sensitive test with distractors mixed with targets in a pseudo-random fashion, which is also easy to perform [14,15], the test will be further explained on methods section.

In Brazil imaging tests are quite expensive and difficult to obtain, such a test would help in identification of important deficits post-stroke as HN. Besides, there is a lack of research that compares the performance of patients with unilateral stroke in BT. Therefore, the present study aimed to compare the performance on BT among stroke groups and healthy controls (HC), as well as to evaluate and characterize the assessment of hemineglect through this instrument. We assume that patients with unilateral stroke will have worse performance compared to controls on BT. More specifically, patients with RBD will demonstrate worse outcomes than patients with LBD and controls.

Method

Participants

The participants were 46 adult patients with diagnosis of stroke confirmed on hospital routine neuroimaging; of these, 23 RBD and 23 LBD. There were also 46 HC. Participants were matched for age, schooling and frequency of reading and writing habits (FRWH). The FRWH was evaluated using an inventory which includes questions about reading (magazines, newspapers, book and other materials) and writing (text messages, letters and other materials) habits, and the frequency of each activity was scored as follows: 4 points for every day, 3 for several days a week, 2 for once a week, 1 for rarely and 0 for never, with a maximum frequency score of 28 points. In this sample, 14 points band was regarded as median. Scores higher and lower than 14 were thus denominated high FRWH or low FRWH, respectively [16].

Stroke patients who had a psychiatric history or other neurological impairment besides stroke, use of antipsychotics and/or illicit drugs, left-handedness according to the Edinburgh Handedness Inventory [17], sensory disorders (uncorrected auditory and visual disorders) were excluded. The same exclusion criteria were used for the controls, except for the presence of stroke. Moreover, signs of cognitive impairment were measured by scores of the Mini-Mental State Examination (MMSE) where cutoff scores of 22 and 24 were used for participants with 5 to 8 years and 9 or more years of formal schooling, respectively [18]. The patients were selected in hospitals, outpatient centers and by convenience sample; controls, in turn, were selected by convenience in peer groups. **Table 1** shows the sociodemographic characteristics of the three groups such as the scores in MMSE, in depression scales e.g. the reduced version of the Geriatric Depression Scale – GDS-15 [19,20] administrated to clinical groups, and Beck's Depression Inventory – BDI [21,22] administrated to HC group, and post-injury time in months.

According to the information in **Table 1**, the only variable that distinguished the groups was MMSE score. This finding was expected because of the type of neurological impairment; since this screening test was designed to measure cognitive aspects, performance tends to be lower due to neuropsychological sequelae.

Procedures

Patients were invited to participate in this study after selection by the physician or analysis of medical records in public and private hospitals of Rio Grande do Sul, Brazil. The participants who agreed to participate signed a free informed consent form and were individually assessed in lighted, clean and well-ventilated rooms. The instruments were administered in one session, lasting approximately one hour. However, patients who demonstrated signs of fatigue were evaluated in two 30-minutes sessions. Administration, recording and scoring of tests was conducted by neuropsychologists or graduate students in psychology rigorously trained. After analysis of the results of each testing, the results were returned to the participants who expressed their wish and all the necessary steps were taken. Concerning the selection of the healthy participants, these were recruited from the BT standardization database [23]. This study was approved by the Research Ethics Committee of Pontifical Catholic University of Rio Grande do Sul (number 09/04908).

Instruments

The BT [14] is an instrument with distractors that requires visual exploration in a horizontally disposed A4 sized sheet of paper. The test consists of 315 stimuli, with 280 distractors, familiar figures such as houses, horses, among others, and 35 target stimuli, which are bell figures. The stimuli are pseudo-randomly organized in seven columns containing five bells each. These columns are positioned in the sheet of paper as follows: three on the left side, one in the middle and three on the right side of the page. In the version adapted to Brazil by Fonseca et al. [24], the participant is asked to cross out all the bells found. There

©Copyright iMedPub

Table 1 Socio-demographic and clinical characterization.

	RBD		LBD		HC		F/χ^2	p	Post hoc
	M	SD	M	SD	M	SD			
Age (years)	55.65	14.37	55.87	12.54	55.37	14.47	0.01	0.99	
Sex Female/Male	12/11	-	12/11	-	33/13	-	0.15	0.15	
Education (years)	10.65	5.10	10.17	3.41	10.41	4.00	0.08	0.93	
Reading and writing	12.65	6.85	13.78	7.60	13.48	5.24	0.20	0.82	
MMSE	24.91	3.68	25.78	1.98	27.91	1.95	12.82	≤ 0.001	(RBD = LBD) < HC**
Post-injury time	19.90	20.42	18.25	16.04	-	-	2.13	0.77	
	n	%	n	%			Fisher's Exact Test	p	
General lesion site									
Cortical	8	34.80	8	34.80	-	-	1.60	0.45	
Subcortical	6	26.10	12	52.20	-	-			
Cortical and subcortical	3	13.00	2	8.70	-	-			
Not reported	6	26.10	1	4.30	-	-			
Depressive symptoms*									
Minimal	12	52.17	16	69.57	42	91.30	19.18	0.28	
Mild	4	17.39	2	8.70	4	8.70			
Moderate	3	13.04	4	17.39	0	0.00			
Severe	4	17.39	1	4.35	0	0.00			

Note. RBD = Right Brain Damage group; LBD = Left Brain Damage group; HC = Healthy Control group; MMSE = Mini-Mental State Examination; * = Stroke patients were evaluated with GDS-15 and healthy controls with BDI; ** = $p \leq 0.001$

are two periods of observation of target search and cancellation: 1) before the clue and 2) after the clue. In the first period, the participants indicate that they have done the task; then, they are asked if they have marked all the bells, which is a clue. After this clue, the second period is added to the first period to form the total execution time.

The quantitative variables of BT investigated in comparative analyzes in the first time were: number of omissions in each column (1, 2, 3, 4, 5, 6 and 7), to the left (total in columns 1, 2 and 3); in central column (column 4); to the right (total in columns 5, 6 and 7); score of omissions in the left visual field minus omissions in the right visual field; total score of distractors (figures others than bells, ie, errors) in each one of the columns and the total number of distractors (errors). In the second moment/period after the clue: "Are you sure you have marked all the bells?", left, middle and right omission were observed; a score of left minus right omissions, as well as the existence or non-existence of cancelled distractors on the left, in the middle column and on the right of the page. Also, the time spent in task execution before the clue and the total time spent in the task were assessed. The categorical or qualitative variables of BT include the column where the first bell was cancelled and the type of strategy used for search (organized or chaotic).

Data analysis

Based on One-Way ANOVA analysis, with post-hoc Bonferroni, sociodemographic data and quantitative dependent variables of BT were compared among the groups. The significance level considered was $p \leq .05$, and SPSS 17.0 program was used. For analysis of frequency of deficits and associations/dissociations between the cases, calculation of z score for each case was used, based on quantitative and qualitative analyzes for scores of errors, omissions and time (mean of the normative group – patient score/ standard deviation of the normative group), using the cut-off point ≤ -1.5 for scores of correct answers and ≥ 1.5 for errors and time suggested in the literature [25]. The percentages of deficits among the groups were compared by Chi-square test, except for distribution regarding depression levels that was compared by Fisher's exact test.

Results

Table 2 shows the mean scores in quantitative variables of BT by group (RBD, LBD, and HC). The results of One-way ANOVA and *post-hoc* tests are seen in the last columns.

According to **Table 2**, group effect was observed for just 10 of the 25 scores evaluated by the BT, with the RBD group showing a performance significantly lower than HC ($p \leq .05$ and $p \leq .01$). However, in general, there were no significant differences between the clinical groups, except in processing speed (total time of BT). The sum of columns three, four and five was used because a greater number of central omissions are suggestive of more severe hemineglect [14]. **Table 3** uses the frequency of deficits for each assessed case for analysis of associations and dissociations.

Most omissions of RBD patients were on the left columns, while the LBD patients showed deficits in both sides. There is only one occurrence of left HN among the cases of RBD and LBD (**Table 3**). 43% RBD patients were bilateral neglect, while approximately twice this percentage was found in the cases of LBD, with greater intensity in two patients with HN in the right visual field. In RBD cases, there are three dissociations with HN only in the left side. Thus, calculation of z scores of the total left minus right omissions has made it possible to detect four cases of left HN syndrome and

©Copyright iMedPub

Table 2 Comparison of mean and standard deviation between groups of the Bells test scores.

	RBD		LBD		HC		F	p	Post hoc
	M	SD	M	SD	M	SD			
Period before the clue									
Omissions col 1 (L)	0.96	1.72	0.83	1.23	0.52	0.81	1.16	0.32	
Omissions col 2 (L)	0.87	1.29	0.78	1.00	0.48	0.66	1.64	0.20	
Omissions col 3 (L)	0.87	1.25	0.52	0.67	0.30	0.66	3.41	0.04	RBD > HC*
Omissions col 4	1.04	1.55	0.73	1.12	0.24	0.52	5.15	0.01	RBD > HC*
Omissions col 5 (R)	0.78	1.31	0.70	0.93	0.43	0.75	1.20	0.31	
Omissions col 6 (R)	0.61	0.99	0.61	1.12	0.24	0.43	2.44	0.09	
Omissions col 7 (R)	0.43	0.79	0.43	0.73	0.20	0.45	1.69	0.19	
Omissions col 3+4+5	2.70	3.60	1.91	2.26	0.98	1.24	4.54	0.01	RBD > HC**
Omissions L	2.70	3.71	2.13	2.47	1.28	1.22	2.91	0.06	
Omissions R	1.83	2.57	1.74	2.14	0.87	1.05	2.91	0.06	
Omissions L-R	0.87	2.74	0.57	1.50	0.43	1.38	0.43	0.65	
Total omissions	5.57	6.93	4.52	5.21	2.41	2.09	4.13	0.02	RBD > HC*
Errors L	0.04	0.21	0.04	0.21	0.00	0.00	1.01	0.37	
Errors Middle	0.00	0.00	0.00	0.00	0.00	0.00	.	.	
Errors R	0.00	0.00	0.00	0.00	0.00	0.00	.	.	
Errors L-R	0.04	0.21	0.04	0.21	0.00	0.00	1.01	0.37	
Total erros	0.04	0.21	0.04	0.21	0.00	0.00	1.01	0.37	
Period after the clue									
Omissions L	1.91	3.63	0.78	1.31	0.39	0.83	4.43	0.01	RBD > HC*
Omissions Middle	0.52	1.24	0.26	0.62	0.02	0.15	4.05	0.02	RBD > HC*
Omissions R	0.91	1.73	0.83	1.27	0.26	0.57	3.30	0.04	-
Omissions L-R	1.00	3.32	0.04	.82	0.30	1.84	2.32	0.10	-
Total omissions	3.35	5.61	1.87	3.02	0.67	1.14	5.20	0.01	RBD > HC*
Execution time (seconds)									
Before the clue	154.43	73.15	111.00	36.75	93.44	34.70	12.62	≤ 0.001	(RBD = LBD) > HC***
After the clue	84.93	41.01	73.47	28.29	49.75	14.44	14.91	≤ 0.001	(RBD = LBD) > HC***
Total	245.77	82.33	186.21	58.82	143.10	41.72	22.16	≤ 0.001	RBD > LBD> HC***

Note. RBD = Right Brain Damage group; LBD = Left Brain Damage group; HC = Healthy Control group; Col = Column; L = Left; R = Right; * = p ≤ .05; ** = p ≤ .01; *** = p ≤ .001.

one case of right HN syndrome in patients with RBD, while in the patients with LBD there were only two cases of left HN syndrome and one case of right HN syndrome.

Discussion

In this study, three groups were analyzed for comparison and clarification of the findings regarding lateralization and normal attentional, visual-spatial and peripersonal performance as done in the early studies on BT of Gauthier et al. [14]. These authors compared the performance of 20 patients with RBD, 20 patients with LBD and 19 controls, and concluded that the cut-off point would be greater than four omissions on one side of the page, since no control had reached this score. The study was replicated by Vanier et al. [15] who concluded that this cut-off point should be used. In this incipient Brazilian study, the findings corroborate the traditional data obtained in clinical neuropsychology studies. Regarding the performances of the participants, the maximum number of bells omitted in the visual fields by the controls was three. Thus, it can be said that more than four omissions may be suggestive of HN in the corresponding visual side; so, this cut-off point should always be adjusted according to schooling and age [26].

Moreover, according to Gauthier et al. [14], omissions of bells in the first left or right columns suggest mild HN syndrome. However, if omissions occur in more central columns, the condition is considered more severe, which can be observed in the worse performance of RBD patients in columns 3 on the left and column 4, middle, as well as in the sum of omissions in columns 3, 4 and 5.

In the study of Ferber and Karnath [27], the authors suggest that a diagnosis of HN is considered when the minimum number of omissions in a cancellation test ranges from 13 to 15% of the targets to be cancelled, which is equivalent to five omissions in BT. By assuming this cut-off point, the diagnosis of HN in this sample was observed in five patients with RBD, which is equivalent to 22% of the sample. The result is similar to the findings of the Brazilian study conducted by Lopes et al. [28] who assessed 102 cases and identified 22 patients with HN (21.56%) through the Behavioral Inattention Test, which is composed of

©Copyright iMedPub

Table 3 Z Scores of omissions in the bells test for each stroke patient.

RBD			LBD		
Patients	After the clue		Patients	After the clue	
	Left	Right		Left	Right
Case 01	0.19	0.00	Case 01	0.38	0.22
Case 02	0.19	0.00	Case 02	0.57	0.53
Case 03	0.38	0.22	Case 03	0.32	0.31
Case 04	0.57	0.53	Case 04	0.48	0.41
Case 05	0.56	0.56	Case 05	0.44	0.66
Case 06	0.45	0.00	Case 06	0.38	.022
Case 07	0.51	0.54	Case 07	0.19	0.00
Case 08	0.32	0.31	Case 08	0.44	0.66
Case 09	0.48	0.41	Case 09	0.45	0.00
Case 10	0.32	0.31	Case 10	0.57	0.53
Case 11	0.57	0.53	Case 11	0.32	0.31
Case 12	0.57	0.53	Case 12	0.56	-1.20
Case 13	-0.45	0.45	Case 13	0.45	-1.10
Case 14	0.38	0.22	Case 14	0.44	-0.95
Case 15	-0.68	0.54	Case 15	0.45	-0.32
Case 16	-0.50	-0.95	Case 16	-0.50	0.66
Case 17	-0.68	-3.04	Case 17	-1.16	-0.40
Case 18	-6.36	-1.33	Case 18	-0.50	-0.95
Case 19	-6.36	-5.98	Case 19	-4.57	0.41
Case 20	-4.24	-4.19	Case 20	-1.44	-4.80
Case 21	-6.00	-2.55	Case 21	-4.63	-3.19
Case 22	-13.29	-0.40	Case 22	-4.89	-2.96
Case 23	-27.38	-1.10	Case 23	-4.89	-6.48

Note. RBD = Right Brain Damage group; LBD = Left Brain Damage group.

three cancellation tasks (Line Crossing, Letter Cancellation, Star Cancellation). The study of Ferber and Karnath [27] showed that the most sensitive instrument for assessment of HN were the BT and Letter Cancellation; however, the second instrument has distractors with strong linguistic components, which involves information processing in the left hemisphere, while non-verbal random figures are more strongly associated with the processing of the right hemisphere [29]. On the other hand, no patient with RBD had HN in the present study; nevertheless, in a study of Beis et al. [2] with a sample of 89 patients who had LBD, 12.8% of them had HN. The authors suggest that HN is generally two to four times more frequent in adults with RBD than in the LBD. In this study, the difference between the presence of HN in both groups was five times.

Regarding the time spent in the execution of the task, the performance of the clinical groups was worse than controls. Patients with RBD had a lower performance than those with LBD. Furthermore, RBD patients need more time to detect shapes than patients with LBD; and HC are significantly faster than RBD and LBD patients [30]. It is important to emphasize that patients with RBD show slower reaction to targets on the left side and difficulty to switch attention from one clue in the right hemispace to the left hemispace when required by a task [29]. Thus, apparently the differences between of the three groups showed RBD worst performance, this data indirectly reinforces the accuracy deficit in this clinical group. In addition to the deficits detected, the study found that the clues helped many patients whose main deficits were attentional. Thus, the scores of those patients with a real dysfunction were considered.

Based on analyzes of discrepancies and associations and dissociations of the lateralization of deficits, it was found that seven RBD patients who presented deficits, six presented HN for the left side while four presented HN for the right side. On the other hand, a higher number of LBD cases had bilateral and ipsilateral deficits, and none of them were contralateral to the damaged hemisphere. This result can be explained by the association of spatial attention and right hemisphere that generally causes damage to the side of space contralateral to the damaged hemisphere [31].

Positron emission tomography in healthy adults shows that the superior parietal cortex and the intraparietal sulcus are activated during spatial and non-spatial search tasks [32], and cells of the right parietal lobe are activated by swifts in the right and left visual space, while activation in the left parietal lobe in the ipsilateral side is weaker [33]. Hence, damage to the right parietal lobe may affect not only the left hemispace but also areas in the right hemispace to some degree. Areas on the left in spaces around the target can also be benefitted by cells in the left hemisphere, as well as by cells in the right hemispace. So, this data explain the bilateral and more intense damage on the left side observed in some patients with RBD.

The findings of the abovementioned study corroborate findings of previous studies, suggesting a worse performance of patients

©Copyright iMedPub

with RBD in cancellation tasks, reinforcing the theory of attentional bias [34]. On the other hand, the lack of differences in accuracy variables between patients with LBD and controls, as well as between the groups with LBD and RBD, may indicate that the individuals in the group with LBD have more heterogeneous profiles of HN, a hypothesis strengthened by the analysis of distribution of deficits and associations/dissociations of cases. However it is important to consider the possibility of sample do not present sufficient statistical power to detect group differences. Moreover, the BT seems to be a very useful instrument to assess attention and the HN syndrome, as it managed to distinguish patients with RBD, LBD and HC quantitatively, and predominantly qualitatively, based on signs of other cognitive elements of the process.

Conclusion

Despite its incipient contributions to neuropsychology of HN spectrum disease in Brazil, this study has some limitations that deserve mention. Although there have been no differences between the clinical groups regarding post-injury time, it was very heterogeneous in both groups, which can make it difficult to determine differences due to the heterogeneity between acute and chronic conditions. The same can be said for the heterogeneity of clinical syndromes of stroke. Finally, the use of only one instrument to assess only one type of HN may not have been sufficient to detect all the true positives. Thus, we suggest further studies that include comparisons of the performance obtained by our participants in the BT with performances in other tasks such as reading, writing, constructive praxis and other cancellation tests, as well as the use of ecological tasks, such as classification of currencies in the hotel task [35]. Besides, a larger sample would allow a comparative analysis of clinical subgroups of the larger group of patients with unilateral stroke, such as syndromes of middle cerebral artery strokes vs anterior posterior and of acute subgroups versus chronic subgroups. In general, the use of BT proved to be important to distinguish the assessed groups, and is a tool that can contribute in routine examinations in outpatient units, medical offices and bed assessments, because it is a quick procedure with a wide variety of clinical inferences. Moreover, the inclusion of other clinical samples e.g. traumatic brain injury and sensitivity in further studies for comparison will help to improve the use of BT as a tool for assessing attention and, more specifically, HN.

Conflict of Interest

All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript. There is no funding or conflict of interest and there are no financial disclosures.

©Copyright iMedPub

References

1 Vossel S, Eschenbeck P, Weiss PH, Weidner R, Saliger J, et al. (2011) Visual extinction in relation to visuo-spatial neglect after right-hemispheric stroke: Quantitative assessment and statistical lesion-symptom mapping. Journal of Neurology, Neurosurgery & Psychiatry 82: 862-868.

2 Beis JM, Keller C, Morin N, Bartolomeo P, Bernati T, et al. (2004) Right spatial neglect after left hemisphere stroke: qualitative and quantitative study. Neurology 63: 1600-1605.

3 Gianotti G, Messerli P, Tissot R (1972) Qualitative analysis of unilateral spatial neglect in relation to laterality of cerebral lesions. Journal of Neurology, Neurosurgery and Psychiatry 35: 545-550.

4 Shulman GL, Pope DLW, Astafiev SV, McAvoy MP, Snyder AZ, et al. (2010) Right hemisphere dominance during spatial selective attention and target detection occurs outside the dorsal fronto-parietal network. The Journal of Neuroscience 10: 3640-3651.

5 Weintraub S, Mesulam MM (1988) Visual hemispatial inattention: Stimulus parameters and exploratory strategies. Journal of Neurology, Neurosurgery, and Psychiatry 51: 1481-1488.

6 Azouvi P, Bartolomeo P, Beis JM, Perennoud D, Pradat DP, et al. (2006) A battery of tests for the quantitative assessment of unilateral neglect. Restorative Neurology and Neuroscience 24: 273-285. Retrieved from http://iospress.metapress.com/content/ajhnqw25xry2hq5k/?genre=article&issn=0922-6028&volume=24&issue=4&spage=273

7 Plummer P, Morris ME, Dunai J (2003) Assessment of unilateral neglect. Journal of Physical Therapy 83: 732-740. Retrieved from http://ptjournal.apta.org/content/83/8/732.extract

8 Buxbaum LJ, Palermo MA, Mastrogiovanni D, Read MS, Rosenberg PE, et al. (2008) Assessment of spatial attention and neglect with a virtual wheelchair navigation task. Journal of Clinical and Experimental Neuropsychology 30: 650-660.

9 Appelros P, Nydevik I, Karlsson GM, Thorwalls A, Seiger A (2003) Assessing unilateral neglect: Shortcomings of standard test methods. Disability and Rehabiliation 25: 473-479.

10 Guariglia P, Matano A, Piccardi L (2014) Bisecting or not bisecting: This is the neglect question. Line bisection performance in the diagnosis of neglect in right brain-damaged patients. Plos One 9: 1-17.

11 Jehkone M, Laihosalo M, Koivisto AM, Dastidar P, Ahonen JP (2007) Fluctuation in spontaneous recovery of left visual neglect: A 1-year follow-up. European Neurology 58: 210-214.

12 Lezak MD, Howieson DB, Bigler ED, Tranel D (2012) Neuropsychological assessment. (5thedn) Oxford University Press. New York, NY.

13 Schubert F, Spatt J (2001) Double dissociations between neglect tests: Possible relation to lesion site. European Neurolology 45: 160-164.

14 Gauthier L, Dehaut F, Joanette Y (1989) The Bells Test: A quantitative and qualitative test for visual neglect. International Journal of Clinical Neuropsychology 11: 49-54. Retrieved from http://strokengine.ca/assess/pdf/bellstest.pdf

15 Vanier M, Gauthier L, Lambert J, Pepin EP, Robillard A, et al. (1990) Evaluation of left visuoespatial neglect: Norms and discrimination power of two tests. Neuropsychology 4: 87-96.

16 Pawlowski J, Remor E, Parente MAMP, Salles JF, Fonseca RP, et al. (2012) The influence of reading and writing habits associated with education on the neuropsychological performance of Brazilian adults. Reading and Writing 25: 2275-2289.

17 Oldfield RC (1971) The assessment and analysis of handedness: The Edinburgh Inventory. Neuropsychologia 9: 97-113.

18 Kochhann R., Varela JS, Lisboa CSL, Chaves MLF (2010) The Mini Mental State Examination: Review of cutoff points adjusted for schooling in a large Southern Brazilian sample. Dementia & Neuropsychologia 4: 35-41. Retrieved from http://www.demneuropsy.com.br/detalhe_artigo.asp?id=199

19 Almeida OP, Almeida SA (1999) Confiabilidade da versão brasileira da Escala de Depressao Geriatrica (GDS) versão reduzida. Arquivos de Neuropsiquiatria 57: 421-426. Retrieved from http://www.scielo.br/scielo.php?pid=S0004-282X1999000300013&script=sci_abstract&tlng=pt

20 Yesavage JA, Brink TL, Rose TL, Lum O, Huang V, et al. (1982-1983) Development and validation of a geriatric depression screening scale: A preliminary report. Journal of Psychiatric Research 17: 37-49.

21 Beck AT, Ward CH, Mendelson M, Mock J, Erbaugh J (1961) An inventory for measuring depression. Archives of General Psychiatry 4: 53-63. Retrieved from http://counsellingresource.com/lib/wp-content/managed-media/beck_at_1961.pdf

22 Cunha JA (2001) Escalas Beck. São Paulo: Casa do Psicólogo.

23 Wong CEI (2012) Estudos neuropsicométricos com o teste de cancelamento dos sinos. Doctoral thesis. Post-Graduation Program in Pscychology of the Pontifícia Universidade Católica do Rio Grande do Sul. Brazil: PUCRS.

24 Fonseca RP, Parente MAMP, Ortiz KZ, Soares ECS, Scherer LC, et al. (2016) Teste de Cancelamento dos Sinos. Sao Paulo: Vetor Editora.

25 Schoenberg MR, Dawson KA, Duff K, Patton D, Scott JG, et al. (2006) Test performance and classification statistics for the Rey Auditory Verbal Learning Test in selected clinical samples. Archives of Clinical Neuropsychology 21: 693-703.

26 Cardoso CO, Silva RFC, Fonseca RP (2011) Teste de Cancelamento dos Sinos: Comparação entre duas versões. Gerais: Revista Interinstitucional de Psicologia 4: 73-80. Retrieved from http://www.fafich.ufmg.br/gerais/index.php/gerais/article/viewFile/121/198

27 Ferber S, Karnath HO (2001) How to assess spatial neglect-line bisection or cancellation tasks? Journal of Clinical and Experimental Neuropsychology 23: 599-607.

28 Lopes MAL, Ferreira HP, Carvalho JC, Cardoso L, Andre C (2007) Screening tests are not enough to detect hemineglect. Arquivos de Neuropsiquiatria 65: 1192-1195.

29 Mesulam MM (1999) Spatial attention and neglect: Parietal, frontal and cingulated contributions to the mental representation and attentional targeting of salient extrapersonal events. Philosophical Transactions of the Royal Society London 354: 1325-1346.

30 Aglioti S, Smania N, Barbieri C, Corbetta M (1997) Influence of stimulus salience and attentional demands on visual search patterns in hemispatial neglect. Brain and Cognition 34: 388-403.

31 Petersen SE, Corbeta M, Miezin FM, Shulmanpet P (1994) Studies of parietal involvement in spatial attention: Comparison of different task types. Canadian Journal of Experimental Psychology 48: 319-338.

©Copyright iMedPub

32 Coull JT, Frith CD (1998) Differential activation of right superior parietal cortex and intraparietal sulcus by spatial and nonspatial attention. Neuroimage 8: 176-187.

33 Corbetta M, Shulman GL, Miezin FM, Petersen SE (1995) Superior parietal cortex activation during spatial attention shifts and visual feature conjunction. Science 270: 802-805.

34 Sutter PS (1995) Rehabilitation and management of visual dysfunction following traumatic brain injury. In M. J. Ashley & D. K. Krych (eds.), Traumatic Brain Injury Rehabilitation, Boca Raton: CRC Press pp: 187-216.

35 Manly T, Hawkins K, Evans J, Woldt K, Robertson IH (2002) Rehabilitation of executive function: facilitation of effective goal management on complex tasks using periodic auditory alerts. Neuropsychologia 40: 271-281.

©Copyright iMedPub