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COMPARATIVE STUDY OF CLINICAL EFFECTIVENESS OF LURIA-NEBRASKA NEUROPSYCHOLOGICAL BATTERY, EEG AND CT SCAN IN BRAIN DAMAGED PATIENTS

M.X. JAMES, A. NIZAMIE & S. HAQUE NIZAMIE

ABSTRACT

The clinical effectiveness and concurrent validity of Luria-Nebraska Neuropsychological Battery (LNNB) was assessed in a sample of 30 brain-damaged and 30 non-patient, normal control subjects. Both the groups were matched for age, sex and education. There were highly significant differences between the mean scale scores of the two groups on all LNNB clinical scales. Brain damaged patients did poorer than normal controls. The LNNB had a hit rate of 86.66% in diagnosing brain-damaged patients in comparison to 70% and 52% of EEG and CT scan respectively. The three measures were found to be significantly correlated with each other. The LNNB was found to be an effective instrument for neuropsychological assessment.

Key words: LNNB, EEG, CT scan, brain damage

The Luria-Nebraska Neuropsychological Battery (LNNB) (Golden et al., 1985) is a widely used tool for assessing the general and specific cognitive deficits secondary to brain damage. Its reliability and validity have amply been reported (Golden et al., 1981a, b; Moses and Golden, 1980). The LNNB has been successfully used in different cultures. Donias et al. (1989) reported the high reliability and clinical effectiveness of the Greek standardized version of LNNB. They reported a hit rate of 82% for controls and 78% for the brain-damaged subjects. Yun et al. (1987) tested the reliability and validity of the Chinese revision of LNNB on 50 brain-damaged group. The discriminant analysis indicated an accuracy of 97% in determining brain-damaged and 90% for lateralization.

In India, Luria's approach for eliciting congnitive deficits has been used in clinical practice. A number of studies have been carried out using the original version of the LNNB (Nizamie et al., 1988; Panda, 1988). The findings of these studies were encouraging. They reported the efficacy and utility of the LNNB in assessing the general and specific cognitive deficits among various clinical population.

However, a comparative study of the LNNB against established diagnostic tools for organicity has not been done on Indian subjects. In the present study performance on LNNB of the brain-damaged patients was compared with non-patient, normal controls. The findings on LNNB of the brain-damaged subjects were compared with the EEG and CT scan.

MATERIAL AND METHOD

Thirty brain-damaged (M27, F3) and 30 normal subjects (M28, F2) were taken for the study. They were matched for age and education. Mean age of both the groups was 31.73±11.89 years and the mean education was 10.03±4.21 years. There was no significant difference between the groups. The brain-damaged subjects were inpatients in the Central Institute of Psychiatry, Ranchi. They had organic mental disorder (DSM-III-R) (A.P.A., 1987) or neurological diseases. Most of the cases are of epilepsy, head injury, neuroinfection and degenerative diseases. The clinical diagnosis was made by an attending psychiatrist (SHN). A 16-channel EEG was done in all the cases in the brain-damaged group. CT scan where available was also taken into consideration. EEG, CT scan and LNNB were interpreted independently. The investigators reading EEG, CT scan and LNNB were blind to findings of each other.

The control group was chosen randomly from the staff of the Institute and members of the community who volunteered for the study. In this group no

subject had a history of brain injury, mental illness, substance abuse, mental retardation or any physical illness.

Each subject was interviewed. All of them met the necessary inclusion criteria. Informed consent was obtained from each of the subjects. The LNNB was administered individually to all subjects. In the brain-damaged group it was administered only after a patient was settled and cooperative for the test. The subjects were seated comfortably in a distraction free testing room. Instructions for the administration were followed as given in the LNNB manual (Golden et al., 1985). Since most of the subjects spoke Hindi, instruction was given in this language without changing the content of the items. In the patients group the battery was administered usually in 3-4 sessions on successive days. For the normal controls a single session sufficed. The scoring of LNNB was done according to the guidelines given in its manual. In the present study, findings on 11 clinical scales were taken into consideration. In few cases educational level was adjusted depending on the clinical judgement. In general, three scaled score above the critical level (Golden et al., 1985) was considered to be indicative of brain-damage while zero or only one elevated scale suggested absence of brain-damage. The EEG was a 16-channel record using international 10-20 system of electrode placement. It was done in every brain-damage case. The CT scan was available in 25 cases of the brain-damaged group. Appropriate statistical analysis to assess the discriminative and concurrent validity of the battery using descriptive statistics, mean, standard deviation, percentage analysis and biserial and tetrachoric correlation were done.

RESULTS

The LNNB identified 26 of the 30 brain-damaged cases and all of the 30 normal subjects according to the criterion of three or more scale (out of 11 clinical scales) above the critical level. The hit rate was 86.66% and 100% for brain-damaged and normal groups respectively. On the whole LNNB correctly classified 56 of 60 subjects with a hit rate of 93.33%.

The mean and standard deviation were calculated for each 11 clinical scale. Differences between the two groups were determined by two-tailed 't' test (Table 1). The brain-damaged group performed significantly poor on all the clinical scales.

TABLE 1

MEANS, SDS AND T-VALUES OF LNNB SUBSCALES ON BRAIN DAMAGED AND NORMAL GROUPS

SCALE	BRAIN DAMAGED		NORMALS		't' VALUES*
	M	SD	M	SD	
C1	57.70	17.95	33.40	02.22	11.05*
C2	70.73	12.98	40.33	03.47	12.27*
C3	55.79	16.27	37.52	03.67	05.89*
C4	61.83	14.78	46.90	09.06	04.70*
C5	58.37	16.17	35.32	04.81	07.35*
C6	55.50	15.34	36.80	05.03	06.27*
C7	56.37	17.97	42.56	04.85	07.35*
C8	52.77	09.67	41.04	04.26	06.68*
C9	65.81	22.62	43.60	04.86	05.68*
C10	64.25	15.14	35.04	05.04	09.68*
C11	69.21	14.37	43.60	07.27	08.78*

d.f. = 58, *p < .01 level

On comparing the EEG and CT scan with LNNB, the hit rate for EEG and CT scan was 70% (21 out of 30 cases) and 52% (13 out of 25 cases) respectively while it was 86.66% (26 out of 30 cases) for LNNB. The percentage of agreement in diagnosis using the three procedures (LNNB, EEG & CT scan) was 68% for LNNB and EEG and 60% for LNNB and CT scan.

TABLE 2

TETRACHORIC CORRELATION OF LNNB AND EEG

	LNNB-	LNNB+	Total
EEG+	2 (B)	19 (A)	21
EEG-	2 (D)	7 (C)	9
Total	4	26	30

rt= 0.374, p<0.05

TABLE 3

TETRACHORIC CORRELATION OF LNNB & CT SCAN

	LNNB-	LNNB+	Total
CT Scan+	1 (B)	12 (A)	13
CT Scan-	3 (D)	9 (C)	12
Total	4	21	25

rt.= 0.500, p<0.01

The LNNB scores of brain-damaged patients were validated against their corresponding EEG and CT scan using tetrachoric correlation (Tables 2 & 3). The significant correlation between the diagnosis of organicity according to LNNB and EEG (Table 2), as well as between LNNB and CT scan (Table 3) indicate that LNNB is effective in identifying brain damage. The individual clinical scale scores of LNNB of this group were correlated using point biserial correlation with their EEG and CT scan (Table 4). The rhythm scale (C2) was not administered in two cases. Thus, C2 scale was not included in the analysis. There was no significant correlation between the LNNB subscales and the EEG, however, expressive speech (C6), writing (C7), reading (C8) and intellectual process (C11) scales had significant correlation with the CT scan findings.

TABLE 4

POINT BISERIAL CORRELATION OF LNNB & EEG AND LNNB & CT SCAN

LNNB SUBSCALE	EEG	CT scan
C1	0.198	0.294
C3	0.0255	0.2286
C4	0.1274	0.254
C5	0.1543	0.250
C6	0.1518	0.3978*
C7	0.0388	0.5638*
C8	0.0797	0.5361**
C9	0.0428	0.1855
C10	0.0534	0.271
C11	0.0474	0.4063*

*P < 0.05 **P < 0.01

DISCUSSION

The results demonstrate a high effectiveness of the LNNB in discriminating the brain-damaged from the normals. The hit rate is similar to the original validation studies with normal and neurological patients (Hammeke, 1978; Moses & Golden, 1979). The use of empirical rule of three or more scales above the critical level successfully discriminated the brain-damaged from the non-patient, normal Indian subject. There was a highly significant difference between the groups on all the scales when the mean 't' scales score of the two groups were compared (Table 1). A direct comparison of mean scores across other studies is difficult (Purisch et al., 1978; Donias et al., 1989) since they have used raw mean scores while it is 'T' mean scores in the present study. However, the significance level in the present study is similar to those reported earlier.

EEG and LNNB findings

The LNNB had a hit rate of 86.66% in comparison to 70% of EEG. The results show that the cognitive deficits in the brain-damaged group were more often picked up by LNNB than the underlying electrophysiological disturbances by the EEG. However, 68% agreement in the diagnosis between the EEG and LNNB measures and a high correlation (0.374,p<.05) suggest high association between the two procedure.

The individual clinical scales were not significantly correlated with the EEG findings (Table 4). It highlights the need to administer a comprehensive test battery and not a few subscales. It may also indicate that the individual cognitive deficits may not have a corresponding electrophysiological correlate since the conventional EEG records the sum total of the electrophysiological status of the brain.

CT Scan and LNNB findings

The CT scan had positive findings in 52 % of the cases. It may be because of the sample composition of the brain-damaged group. The CT scan is reported to be differentially sensitive in different neurological disorders. A negative CT scan does not rule out the presence of brain-damage. The CT scan is most diagnostic in cases of brain tumors though a 10% chance of making an error has been reported

there too (Gawler et al., 1975). In the present study the cases were mostly of epilepsy, head injury, neuroinfections and degenerative diseases. There was no case of brain tumors. A 52% hit rate on CT scan in such a heterogenous group may be considered fair. There was 60% agreement between LNNB and CT scan with a high correlation (·05, p<·01) suggesting interchangeability of the measures in a significant number of cases. This finding becomes significant in Indian context when viewed against the backdrop of limited CT scan facilities and high cost involved. The LNNB may prove a cheaper and very useful diagnostic screening tool. A significant correlation of individual LNNB subscales with CT scan findings suggest a possibility of cognitive deficits being directly related to the structural damage. The LNNB may be useful to the localization of the brain lesions. It must be pointed out, however, that the efficacy of the LNNB in this study is based on the quantitative assessment of the clinical scale profiles only. It is not standardized on Indian population. Its clinical effectiveness will surely be maximized once it is standardized and Indian norms are developed. The high correlations among EEG, CT scan and LNNB measures also suggest the need of taking into consideration other methods of interpretation, e.g., lateralization and localization of lesions, factor scale profiles, quantitative evaluation of item patterns and the presence of specific pathognomonic signs while interpreting LNNB data.

In conclusion, the LNNB in its original form has been found to be highly discriminating and comparatively more effective measure of diagnosing brain-damage. It is also an effective instrument for neuropsychological assessment.

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M.X. JAMES, M.A., M. PHIL, Ex-Postgraduate student in Clinical Psychology, A. NIZAMIE, Ph.D., D.M. & S.P., Assistant Professor of Clinical Psychology, Deepshikha Institute of Child Development & Mental Health, Ranchi, S. HAQUE NIZAMIE, M.D., D.P.M., Associate Professor of Psychiatry, Chief, Psychophysiology & Neurophysiology Laboratories and Epilepsy Programme, Central Institute of Psychiatry, Ranchi.*

**Correspondence*

Conferences

- ☆ XIXth International Association for Suicide Prevention Congress 23-27 March 1997 - Adelaide, South Australia
- ☆ Satellite Workshop to Nice June 22-27 "Economics Therapy Mental Disorders..." (IAFBDR) 21 June 1997 - Monte Carlo
- ☆ Biological Psychiatry 22-27 June 1997 -Nice, France
- ☆ 10th Annual Meeting European College of Neuropsychopharmacology (ECNP-97) September 1997
- ☆ Consensus Meeting on "Schizophrenia" or on "Aging", prior to ACNP Congress (IAFBDR) December 1997 -San Juan, Puerto Rice
- ☆ American College Neurology and Psychiatry (ACNP-97) December 1997-San- Juan, Puerto Rice
- ☆ 8th Congress Association European Psychiatrists (AEP-98) 1998- Copenhagen, Denmark
- ☆ 21st Congress Collegium Internationals Neuropsychopharmacologicum (CINP-98) 12-15 July 1998- Glasgow, Scotland
- ☆ 11th Annual Meeting European College of Neuropsychopharmacology (ECNP-98) October 1998- Paris,France
- ☆ American College Neurology and Psychiatry (ACNP-98) 7-11 December 1998- San Juan. Puerto Rico