Neurological Soft Signs in Schizophrenia: A Cross-sectional Study

Abstract

Context: Soft neurological signs are present more frequently in schizophrenics than other patients suffering from other psychiatric illnesses and normal individuals. Objectives: The objective of this study is to find out the causal relationship of neurological soft signs (NSSs) to schizophrenia. Materials and Methods: The study was initiated after taking approval of the institute ethics committee. A total of thirty schizophrenic patients and thirty controls were included in the study. Their diagnosis was confirmed by consultant and then were administered Neurological Evaluation Scale developed by Robert Buchanan. The accumulated data were then analyzed statistically. Results: This study shows a higher prevalence of NSSs in schizophrenia as compared to controls. Conclusion: To ascertain their role in aetiogenesis and pathogenesis of schizophrenia, further research is needed.

Keywords: Neurological Evaluation Scale, pathogenesis, schizophrenia, soft signs

Introduction

The term “soft neurological signs” was first used by Loretta Bender in 1947.[1] Neurological soft signs (NSSs) are defined as nonnormative performances on a motor or sensory tests, which would be identical to tests of traditional neurological examination but elicited from an individual who shows none of the features of fixed or transient neurological disorder. To consider a sign as a soft neurological sign, it should have features, as discussed below.

There should be no association between observed behavior and a positive history of neurological disease or trauma. It should not be a pathognomic sign of any neurologic disease or encephalopathy. It should not indicate any specific central nervous system pathology.[2] NSSs are considered a normal occurrence in childhood; however, improve as the child grows older. Therefore they are considered to represent a development phenomenon.[3] However, in certain clinical populations, these signs persist or re-emerge. Soft neurological signs reflect disturbed cortical-subcortical connectivity and cortical-cortical interneuronal connections, which are also evident from reduced cortical/subcortical volume.[4]

Soft neurological signs have been extensively studied in schizophrenic patients. Schizophrenia is characterized by delusions, hallucinations, disorganized speech and behavior, negative symptoms, and prolonged course.[5] Krapelin described disorders of equilibrium, tremor, and dysdiadochokinesia, which are considered under the domains of soft neurological signs today.[6] Soft neurological signs are present more frequently in schizophrenics than other patients suffering from other psychiatric illnesses and normal individuals. Torrey observed in 1980 that soft neurological signs are associated with more chronic and severe forms of schizophrenia.[7]

This study was done to find the prevalence of “soft neurological signs” in patients of schizophrenia and to compare the soft neurological signs in patients of schizophrenia and normal controls.

Materials and Methods

Thirty consecutive patients of schizophrenia disorder presenting in a tertiary hospital in North India in the department of psychiatry were selected for the study. In addition, 30 age- and sex-matched patients, who had no personal or family history of mental illness, admitted in the surgical wards of hospital were selected as controls. All patients were subjected to a detailed psychiatric examination.

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Schizophrenia was diagnosed according to the International Classification of Diseases-10 diagnostic criteria. The diagnosis was confirmed by a faculty member to avoid any error. Patients suffering from epilepsy, mental retardation, any organic brain disorder, systemic physical illness (except controls), alcohol dependence or drug abuse, uncooperative patients/patients with severe psychosis whose attention and concentration prevented cooperation were excluded from the study.

All subjects were administered the Neurological Evaluation Scale (NES) devised by Robert W. Buchanan and Douglas W. Heinrichs to record the NSSs present. This consists of a battery of 26 test items. Each item was scored on a three-point scale, i.e., 0: No abnormality, 1 for mild but definitive impairment, 2 for marked impairment (except for snout and suck reflex which were scored 0 or 2).

This instrument included representative items from three functional areas of interest namely-(a) Integrative sensory dysfunction reflected in bilateral extinction, agraphaesthesia, astereognosis, right-left confusion, and impaired audio-visual integration; (b) Motor incoordination reflected in the tandem walk, finger to nose, finger to thumb opposition and dysdiadochokinesia; (c) Impaired sequencing of complex motor acts reflected in fist-ring, fist-edge-palm and Ozeretski tests. In addition cerebral dominance, short-term memory, frontal release signs, and eye movements were also tested.

The accumulated data was then compared separately for differences between patient group and controls. The differences observed were then analyzed for statistical significance by standard methods.

**Results**

Most of the schizophrenics were 20–30 years old males, studied up to secondary level, Sikhs, urban, unemployed, and married [Table 1].

Most of the NSSs were present in schizophrenic patients as compared to controls [Table 2].

NSS score in subject groups were more in schizophrenic patients as compared to controls [Table 3].

The prevalence rates of individual soft neurological signs were compared between the respective study groups. NSS1 – Tandem walk was positive in 3 schizophrenics.

| Table 1: Sociodemographic details of the study participants |
|----------------------------------------------------------|
| **Parameter** | **Category** | **Schizophrenia (%)** | **Control (%)** |
|---------------|--------------|----------------------|-----------------|
| Age (years)   | 10-20        | 3 (10.00)            | 3 (10.00)       |
|               | 20-30        | 13 (43.33)           | 3 (10.00)       |
|               | 30-40        | 8 (26.66)            | 16 (53.33)      |
|               | 40-50        | 1 (3.33)             | 6 (20)          |
|               | 50-60        | 5 (16.66)            | 2 (6.66)        |
| Gender        | Male         | 19 (63.33)           | 15 (50.00)      |
|               | Female       | 11 (36.66)           | 15 (50.00)      |
| Education level | Illiterate   | 0 (0.00)             | 2 (6.66)        |
|               | Primary      | 7 (23.33)            | 3 (10.00)       |
|               | Middle       | 5 (16.66)            | 5 (16.66)       |
|               | Secondary    | 15 (50.00)           | 15 (50.00)      |
|               | Graduate/PG  | 3 (10.00)            | 5 (16.66)       |
| Religion      | Hindu        | 10 (33.33)           | 12 (40.00)      |
|               | Sikh         | 20 (66.66)           | 18 (60.00)      |
|               | Other        | 0 (0.00)             | 0 (0.00)        |
| Residence     | Rural        | 13 (43.33)           | 16 (53.33)      |
|               | Urban        | 17 (56.66)           | 14 (46.66)      |
| Marital status | Married     | 14 (46.66)           | 26 (86.66)      |
|               | Single       | 14 (46.66)           | 4 (13.33)       |
|               | Divorcee     | 2 (6.66)             | 0 (0.00)        |
| Occupation    | Unemployed   | 10 (33.33)           | 2 (6.66)        |
|               | Shopkeeper   | 3 (10.00)            | 5 (16.66)       |
|               | Farmer       | 5 (16.66)            | 8 (26.66)       |
|               | Office worker| 4 (13.33)            | 4 (13.33)       |
|               | Householder  | 7 (23.33)            | 9 (30.00)       |
|               | Student      | 1 (3.33)             | 1 (3.33)        |
| Family type   | Joint        | 15 (50.00)           | 18 (60.00)      |
|               | Nuclear      | 15 (50.00)           | 12 (40.00)      |

| Table 2: Neurological soft signs in subject groups |
|--------------------------------------------------|
| **Neurological soft signs** | **Schizophrenics** | **Controls** |
|-------|-------------------|--------------|
| Tandem walk | 3                | 0            |
| Rombergs sign | 0                | 0            |
| Adventitious overflow | 0                | 0            |
| Tremors | 14                | 1            |
| Cerebral dominance | 26                | 29           |
| Right | 1                 | 0            |
| Left   | 3                 | 1            |
| Mixed  | 8                 | 0            |
| AV integration | 2                | 0            |
| Stereognosis | 18               | 1            |
| Graphesthesia | 26                | 6            |
| Fist ring test | 13               | 0            |
| Fist edge palm test | 18               | 3            |
| Ozeretski test | 13               | 2            |
| Memory  | 13                | 2            |
| Rhythm tapping test | 9                | 1            |
| Rapid alternating movements | 3               | 0            |
| Finger thumb opposition | 2                | 0            |
| Mirror movements | 4                 | 2            |
| Extinction | 3                 | 0            |
| Right left confusion | 8                | 2            |
| Synkinesis | 5                 | 1            |
| Convergence | 0                 | 0            |
| Gaze impersistence | 2                | 0            |
| Finger nose test | 12               | 1            |
| Glabellar reflex | 10               | 2            |
| Snout reflex | 2                 | 0            |
| Grasp reflex | 0                 | 0            |
| Suck reflex | 0                 | 0            |

AV: Audio-visual
NSS2 and 3, i.e., Romberg’s Sign with Adventious Overflow was not found in any patient. NSS 4-Tremors were shown by 14 schizophrenics and 1 controls and the difference was highly significant. Comparison of other indices is shown in Table 3.

### Table 3: Neurological soft sign score in subject groups

| Neurological soft sign                  | Schizophrenics | Controls | Significance of difference |
|----------------------------------------|----------------|----------|----------------------------|
| Tandem walk                            | 3              | 0        | NS                         |
| Romberg’s sign                         | 0              | 0        | -                          |
| Adventious overflow                    | 0              | 0        | -                          |
| Tremors                                | 14             | 1        | HS                         |
| AV integration                         | 13             | 0        | HS                         |
| Stereognosis                           | 2              | 0        | NS                         |
| Graphesthesia                          | 24             | 1        | HS                         |
| Fist ring test                         |                |          |                            |
| Right                                  | 49             | 5        | HS                         |
| Left                                   | 49             | 6        |                            |
| Fist-edge-palm test                    |                |          |                            |
| Right                                  | 19             | 0        | HS                         |
| Left                                   | 19             | 0        |                            |
| Ozeretski test                         | 33             | 3        | HS                         |
| Memory                                 | 18             | 2        | HS                         |
| Rhythm tapping test                    | 15             | 1        | S                          |
| Rapid alternating movement             |                |          |                            |
| Right                                  | 1              | 0        | S                          |
| Left                                   | 4              | 0        |                            |
| Finger thumb opposition                |                |          |                            |
| Right                                  | 1              | 0        | NS                         |
| Left                                   | 1              | 0        |                            |
| Mirror movements                       | 4              | 2        | NS                         |
| Extinction                             | 3              | 0        | NS                         |
| Right left confusion                   | 15             | 2        | S                          |
| Synkinesis                             | 10             | 0        | S                          |
| Convergence                            | 0              | 0        | -                          |
| Gaze impersistence                     |                |          |                            |
| Right                                  | 2              | 0        | NS                         |
| Left                                   | 2              | 0        |                            |
| Finger nose test                       |                |          |                            |
| Right                                  | 9              | 1        | HS                         |
| Left                                   | 12             | 1        |                            |
| Glabella reflex                        | 17             | 2        | S                          |
| Snout reflex                           | 4              | 0        | NS                         |
| Grasp reflex                           | 0              | 0        | -                          |
| Suck reflex                            | 0              | 0        | -                          |

AV: Audio-visual

Discussion

An increased prevalence of NSSs has been found in schizophrenia. It has been suggested that in conditions like schizophrenia which run a prolonged course over several years, these signs show stability over time and serve as trait markers.

In the present study, soft neurological signs were studied in 30 schizophrenics and compared with 30 age- and sex-matched admitted patients in surgical wards of the hospital. All patients were subjected to a comprehensive NES, consisting of a battery of 26 items devised by Buchanan and Heinrichs.

Compared to normal controls, the schizophrenics had a higher prevalence of soft signs. Highly significant differences were found for: Tremors - All positive (46.66%) scored 1 as compared to normal (16.66%) indicating the tremors were always fine ($P < 0.001$); Impaired audio-visual integration existed in 26.66% cases of schizophrenia but not in any control subjects ($P < 0.01$); Agraphesthesa - The prevalence in schizophrenia was 53.33% as against 3.33% in controls ($P < 0.001$); Fist-ring test - Most schizophrenics (86.66%) performed very
poorly in this test with a severity score of 2, whereas only 20% control displayed this abnormality \( P < 0.000001 \);
Fist-edge–palm test was positive in 43.33% schizophrenics but not in any control subjects \( P < 0.0001 \); Ozeretski test was found positive in 53.33% schizophrenics but only 10% controls \( P = 0.0001 \); memory defects occurred in 43.33% schizophrenics and 6.66% controls \( P < 0.01 \); Finger-nose test was prevalent in 40% schizophrenics and only 3.33% controls \( P < 0.001 \). Significant differences were also found for rhythm tapping test, rapid alternating movements, right-left confusion, synkinesis, and glabellar tap.

No significant differences from controls were found for tandem walk, Romberg’s sign and adventitious overflow, stereognosis finger-thumb opposition, mirror movements, extinction, convergence, gaze impersistence, snout reflex grasp reflex, and suck reflex. The above results are similar to those of the previous studies done by Rochford et al.,[8] Quitkin et al.,[9] Tripathi et al.,[10] Walker and Shaye,[11] Nasrallah et al. and Buchanan et al.[12] Krakowski et al.,[13] Gupta et al.,[14] and Karp and Garvey.[15]

The present study produced similar results but no laterality was observed. Besides, the present study did not include tests for speech abnormality and hoping on foot. Abnormalities of sequencing of complex motor acts were prominent amongst schizophrenics in the present study. The differences in the prevalence of neurological impairment on individual item may be related to differences in the comprehensiveness of assessment procedures, variability of the control groups or sensitivity of the scoring guidelines. Despite this a consistent agreement exists across all studies in impairment of complex motor acts, motor coordination, integrative sensory function, and memory in schizophrenia.

**Limitations**

Present study was nonblind, sample size was small. It was not strictly possible to include only drug naïve patients. The effect of medication on soft signs could not be determined and it may be significant. Soft signs could not be studied in grossly psychotic schizophrenics. Therefore, the relation of soft signs to the severity of schizophrenics could not be determined.

**Conclusion**

The present study concluded that as compared to normal controls the schizophrenics had a higher prevalence of soft signs. The higher prevalence of soft neurological signs in schizophrenia has expanded the evidence for organic basis in the etiology and pathogenesis of schizophrenia, however there is a need for a universally accepted, structured and reliable procedure for rating NSSs so that results as well as comparisons across studies can be bone authentically.

**Ethical clearance**

Study was conducted after approval from the Institutional Ethics Committee.

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Nil.

**Conflicts of interest**

There are no conflicts of interest.

**References**

1. Sanders RD, Keshavan MS. The neurologic examination in adult psychiatry: From soft signs to hard science. J Neuropsychiatry Clin Neurosci 1998;10:395-404.
2. Sadock BJ, Sadock VA, Ruiz P. Synopsis of Psychiatry: Behavioral sciences/Clinical Psychiatry. 10th ed. New Delhi: Wolters Kluwer; 2007. p. 1472.
3. Shaffer D, Oconnor PA, Shafer SQ, Prupia S. Neurological “soft signs”: Their origin and significance for behaviour. In: Rutter M (ed). Developmental Neuropsychiatry. New York: Guilford Press; 1983;144-63.
4. Browne S, Clarke M, Gervin M, Lane A, Waddington JL, Larkin C, et al. Determinants of neurological dysfunction in first episode schizophrenia. Psychol Med 2000;30:1433-41.
5. King DJ, Wilson A, Cooper SJ, Waddington JL. The clinical correlates of neurological soft signs in chronic schizophrenia. Br J Psychiatry 1991;158:770-5.
6. Arango C, Bartko JJ, Gold JM, Buchanan RW. Prediction of neuropsychological performance by neurological signs in schizophrenia. Am J Psychiatry 1999;156:1349-57.
7. Hollander E, Liebowitz MR, Rosen WG. Neuropsychiatric and neuropsychological studies in obsessive-compulsive disorder. In: Zohar J, Insel T, Rasmussen S, editors. Psychobiology of Obsessive Compulsive Disorder. New York: Springer-Verlag; 1991. p. 126-45.
8. Rochford JM, Detre T, Tucker GJ, Harrow M. Neuropsychological impairments in functional psychiatric diseases. Arch Gen Psychiatry 1970;22:114-9.
9. Quitkin F, Ritkin A, Klein DF. Neuologic soft signs in schizophrenia and character disorders. Organicity in schizophrenia with premorbid asociality and emotionally unstable character disorders. Arch Gen Psychiatry 1976;33:845-53.
10. Tripathi R, Soni A, Tyagi A, Mehta S, Gupta S. Comparative Study of Neurological Soft Signs in Patients with Schizophrenia or Obsessive-compulsive Disorder, and Healthy Controls. East Asian Arch Psychiatry 2015;25:64-72.
11. Walker E, Shaye J. Familial schizophrenia. A predictor of neuromotor and attentional abnormalities in schizophrenia. Arch Gen Psychiatry 1982;39:1153-6.
12. Nasrallah HA, Tippin F, Calley MC. Neurological soft signs in manic patients: A comparison with schizophrenics and control groups. J Affect Disord 1983;5:45-50.
13. Krakowski MI, Convit A, Jaeger J, Lin S, Volavka J. Neurological impairments in violent schizophrenic patients. Am J Psychiatry 1989;146:849-53.
14. Gupta S, Andrews NC, Arndt S, Flauw M, Schulz SK, Hubbard WC, Smith M. Neurological soft signs in neuroleptic naïve and neuroleptic treated schizophrenic patients and in normal comparison subjects. Am J Psychiatry 1995;152:191-6.
15. Karps BI, Garvey M. Abnormal neurological maturation in adolescents with early onset schizophrenia. Am J Psychiatry 2001;158:118-22.