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Neurological soft signs in autism spectrum disorder

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ABSTRACT

Background: Autism spectrum disorder (ASD) is a phenotypically heterogeneous group of neurodevelopemental syndromes characterized by impairments in social communication and restricted & repetitive behavior. Neurological soft signs (NSS) are minor neurological abnormalities that aren't a part of any fixed/transient neurological disorders. The most common NSS in ASD are motor incoordination, difficulty sequencing motor tasks & sensory disintegration.

Materials and Methods: 22 participants of ASD satisfying the inclusion and exclusion criteria were assessed for NSS, using a semi structured performa & Heidelberg manual for neurological soft signs. The data was tabulated and analysed statistically.

Results: The mean age of the participants was 11.63 years with 82% males & 18% females. 100% participants had dysdiadochokinesia (82% -adiadochokinesia), errors in the finger-nose test(71% unable to perform), right-left confusion (39% -making gross errors), difficulty in tandem walking(70% -significant balance problems), difficulty in fist-edge-palm (54% unable to complete task) & ozeretski test (78%-unable to perform). 94% had difficulty in pronation-supination (56%-failed to complete exercise).89% of the participants had difficulty in finger –thumb opposition (63%- unable do it).

Conclusion: NSS are present in a significant amount of patients of ASD & such patients should be assessed for the full spectrum of NSS.

1. Introduction

Autism spectrum disorder (ASD) is a phenotypically heterogeneous group of neurodevelopemental syndromes characterized by impairments in social communication and restricted & repetitive behavior.[1] Neurological soft signs (NSS) are minor neurological abnormalities that aren't a part of any fixed/transient neurological disorders.[2] The most common NSS in ASD are motor incoordination, difficulty sequencing motor tasks & sensory disintegration. Autism is associated not only with difficulty performing skilled movement but also in understanding these movements.[3]

These can be seen in the form disturbances in posture, muscle tone, gait & non purposeful movements like tics, poor balance, hypotonia, reflex abnormalities and toe walking.[4–6] One study reports that the unwillingness/inability of a child with low IQ to do tasks should arouse suspicion of autism.[7]

Dyspraxia has been found to be more common in ASD than general population as well as ADHD, with parents of such patients reporting atypical motor skills as early as 14.7 months of infancy.[3,8,9] Dyspraxia in autism is caused by impaired storage of learned time-space movement representations, mediated by parietal regions; (b) alterations

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in transcoding of these movement representations in the premotor cortex; and defective execution/basic motor skills; mediated by the motor cortex.[9]

Studies also show that impaired proprioception in ASD maybe responsible for motor incoordination, postural difficulties and even disruptive behavior.[10,11] ASD is also associated with sensorimotor dysfunction with sensory processing dysfunction in 90% of the individuals.[12,13]

Recent theories which suggest basis of the neurological dysfunctions in ASD include growth dysregulation hypothesis and the theory of abnormal neural connectivity in individuals with ASD.[14] Considering the evidence of neural origin of ASD, a complete neurological examination including assessment of NSS, which are often missed, should be a part of psychiatric evaluation of ASD.

2. Materials and Methods

The study is a observational cross- sectional study which was conducted in a psychiatry outpatient department of a tertiary care teaching hospital in a total duration of 3 months. 22 consecutive patients of clinically diagnosed autism spectrum disorder were included in the study. The study included patients clinically diagnosed with autism spectrum disorder and patients or carers of patients willing to give written informed consent. Patients already diagnosed with some other major psychiatric or medical condition were excluded from the study. After taking permission from the Institutional Ethics Committee, 22 consecutive patients coming to the psychiatry outpatient department at a tertiary care hospital, fulfilling the inclusion and exclusion criteria participated in the study. Socio-demographic details and neurological evaluation including complete neurological examination was done and data was collected, tabulated and analyzed statistically and results and conclusions drawn from the same. NSS were rated on the Heidelberg Manual for Neurological Soft Signs , made up of 16 items based on five factors i.e motor coordination, sensory integration, complex motor tasks, right/left and spatial orientation and hard signs. Ratings are on a scale of 0–3 (no/ slight/ moderate/ marked abnormality). The psychometric properties of the Heidelberg scale have already been established.[2,15] (2,21,22,23)

3. Results

The mean age of the participants in this study was 11.63 years with 82% males & 18% females.

4. Discussion

The mean age of the participants in this study was 11.63 years with 82% males & 18% females. 9% of the participants had left handedness and 91% had right handedness. 31.8% showed involuntary movements in the form of tremors and stereotypies.14.3% participant had hyporeflexia. A study by Ming X et al reported that hypotonia was the most common motor symptom in ASD (51%) and this improved with time while motor apraxia (34%) was more prevalent in younger children with ASD, toe-walking was found in 19% of children and Gross motor delay was reported in 9% of children.[16] Primitive reflexes were found to be present in 5% of the participants.

Gait disturbances were found in 31.8% of participants with 43% having marked difficulty in walking.100% of the participants had difficulty in tandem walking with 70% having balance problems even with open eyes.

100% of the participants had impaired right-left orientation, of which 39%making gross errors. 83.3% participants had faults in the arm-holding test with 40% of them having arm sinking, loss of finger splaying, finger movements, pronation and differences between the sides. Finger nose test showed 100% of the participants had some difficulty in performing the test with 71% having inaccuracy and trembles of indecision even with open eyes. On the Ozeretzki's test, 100% of the participants made errors with 78% of them having difficulty in coordination and inability to complete any section correctly.

100% of the participants had difficulty in diadochokinesis with 82% having adiadochokinesis. Pronation - supination difficulties were seen in 94% of the participants of which 56% had difficulties even at slow tempo or made gross errors. Paquet A et al while screening for synkinesia in ASD using the diadochokinesia test evidenced adiadochokinesia in 57% of the children. Another test conducted by him called Dynamic equilibrium, was failed by 52% of the ASD children in the form of postural difficulties, difficulties in speed of execution in, walking heel-toe on a line and walking on the heels, where the extension of the arms was characteristic among our ASD children.[17]

89% of participants showed errors in finger – thumb opposition with 63% unable to do it. Mirror movements were perceived in 84% of the participants with 38% having movements similar to those of the active hand. Difficulties in graphesthesia were seen in 50% of the participants with 25% making more than 2-3 errors. Errors in performing fist-edge – palm test were seen in 100% of participants with 54% unable to do any section completely. Difficulties in speech and articulation were seen in 100% of the participants of which 75% had severe alterations and incoherence.

Green et al and Miyahara et al found 80% cases of ASD had definite motor impairment with 10% being borderline.[8,18,19]

Miller et al also found that 60% of ASD cases have difficulty in gesture imitation tasks which suggests motor planning defect.[20]

Berthier ML et al found that in cases of ASD with tourette's, NSS (in motor and somatosensory function) were present in six of seven subjects, while those with Tourette

Table 1:

	Males	Females	Total
No. of participants	18	4	22
Percentage	82%	18%	
Mean age (years)	10.7	16	11.43

Table 2:

	Left handed	Right handed	Invol movements	Hyporeflexia	Primitive reflexes
Percentage of Participants	9%	91%	31.8%	14.3%	5%

Table 3:

Neurological soft sign	Woudn't/couldn't do (WD/CD)	Total participants	Presence of NSS	%age of participants with NSS	Moderate-severe	% age of participant with severe NSS
Gait	0	22	7	31.8%	3	43%
Tandem walking	12	10	10	100%	7	70%
Right/left orientation	9	13	13	100%	5	39%
Arm holding	10	18	10	83.3%	4	40%
Finger-nose test	5	17	17	100%	12	71%
Ozeretzki test	13	9	9	100%	7	78%
Diadochokinesis	5	17	17	100%	14	82%
Pronation-supination	3	19	18	95%	10	56%
Finger-thumb opposition	4	18	16	89%	10	63%
Mirror movements	3	19	16	84%	6	38%
Graphesthesia	14	8	4	50%	1	25%
Fist-edge-palm test	7	15	15	100%	8	54%
Speech	14	8	8	100%	6	75%

syndrome only did not display NSS, thus establishing the neural basis of ASD.[6,21]

De Jong et al found thsat 95% of children with ASD have minor neurological dysfunctions.[14]

This discussion summarizes that coordination problems, sensory dysfunction, and dysfunctional posture and muscle tone regulation were more strongly associated with ASD than with other psychiatric morbidity.

5. Conclusion

Neurological soft signs are present in a significant number of patients of autism spectrum disorders, with all the patients showing impaired right left orientation, dysdiadochokinesis, finger nose test incoordination and speech & articulation difficulties, thus reaffirming the neurological origin of this disorder. For a comprehensive evaluation such patients should be assessed for the full spectrum of neurological soft signs.

6. Limitations

1. Small sample size.
2. Inability to determine if the neurological soft signs are due to ASD or any other psychiatric co-morbidity if present.

7. Source of Funding

None.

8. Interest of Conflicts

None.

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