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To Assess the Sensitivity and Positive Productive Value of Cerebellar Signs in Persons with Known Cerebellar Disorder

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Abstract: There is need for more of scientific studies on the validity of traditional neurological teaching of clinical sign. Many textbook mention several cerebellar signs, but what the evidence base for these mention statements? A thorough search in the literature did not found the incidence of these cerebellar signs in cerebellar disorder and there validity. To assess sensitivity and positive predictive value of each cerebellar sign in cerebellar disorder. Residents in the department of medicine asked to examine healthy control or patients in a random order without giving them any information about the subject. Inability to do Tandem walking, Ataxic-gait, intention tremor, dysdiadochokinesi, dysarthria are having higher sensitivity while hypotonia and pendular knee jerk have lower sensitivity. Out of these 12 cerebellar signs, except Hypotonia and pendular knee jerk all were having statistically significant association.
Keywords: Cerebellar sign, dysdiadochokinesia, dysarthia.

INTRODUCTON

In Latin, the word cerebellum means *little brain.* The cerebellum, which lies just dorsal to the pons and medulla, consists of two highly convoluted lateral cerebellar hemispheres and a narrow medial portion, the vermis. It is connected to the brain by three pairs of dense fiber bundles called the peduncles. Although the structure and function of the cerebellum have long been studied, the precise role of the cerebellum in motor control remains to be fully elucidated.

AIMS & OBJECTIVES

To assess *sensitivity*, positive *predictive value* of each cerebellar sign in cerebellar disorder

MATERIALS & METHOD S

Patient selection

Patients who are visited *OPD* or *admitted* in Jayarogya Hospital Gwalior India, we selected 30 patient of cerebellar disorder & 30 healthy control subject of similar age and sex.

Inclusion criteria

Patient of cerebellar disorder as diagnosed by a senior physician with fulfilling following criteria;

- Age > 15 yrs.
- Patient must be conscious & oriented to time, place & person.
- Patient should follow the command.
- Patient able to walk without support.

Exclusion criteria

- Age <15 yrs.
- Unconscious patient.
- Patient not follows the command.
- Patient no able to walk

Material required

Paper, pencile, knee hammer etc

Each subject / parent gave informed consent for his participation in the study.

The protocol is approved by the hospital ethics committee.

The cerebellum involvement is diagnosed clinically and supported by imaging evidence (CT or MRI imaging), imaging study may be normal or not done.

Cerebellum Involvement may be in the following form;

Acute onset [1]

- Stroke (thrombosis or hemorrhage).
- Trauma.
- Infection (encephalitis, abscess, tuberculoma etc.)
- Demyelinating disorder.
- Drugs toxicity e.g. phenytoin, barbiturate, alcohol.

Gradual onset [1]

- Degenerative, familial & hereditary ataxia.
- Neoplastic lesion (cerebellopontine angle tumor, cerebellar tumor).

Cerebellar sign [2,3,4]
The following is the list of cerebellar sign which may appear in patient of cerebellar disorder;

- Nystagmus
- Hypotonia
- Dysdiadochokinesia
- Dysmetria /past pointing
- Finger nose test
- Heel-knee test
- Intentional tremor
- 8.rebound phenomenon
- Dysarthria
- Pendualar knee jerk
- Ataxia –gait
- Impaired tandem walking

Methods of eliciting cerebellar sign

Three1st year residents in the department of medicine were given a short training course in neurological clinical examination including conventional signs suggestive of involvement of cerebellum (reference- Bickerstaff's Neurological examination in clinical practice).

At the end of the training, the resident's skill were assessed by neurophysician and found to be good. The 1st year residents were then asked to examine healthy control or patients (diagnosed as having any disease of cerebellum and also having clinical signs of cerebellum involvement) in a random order without giving them any information about the subject. The residents were permitted to talk to subjects only to extent of formal greeting, courtsey and instructions for examination but not anything about symptom, diseases, consultations or investigations. Finally ask the residents to mention their findings of present or absent of cerebellr signs.

OBSERVATIONS & RESULTS

In this study I have taken total 30 cases of known cerebellar disorder of different age groups and sexes, amongs them the youngest study subject was 15 year old and oldest was 72 year old with the mean age of cases was 47.2 ± 16.7(mean±S.D.).

In this study I have taken total 30 Healthy subjects of different age groups and sexes, amongs them the youngest study subject was 16 year old and oldest was 75 year old with the mean age of control was 47.96 ± 15.7 (mean ± S.D.).

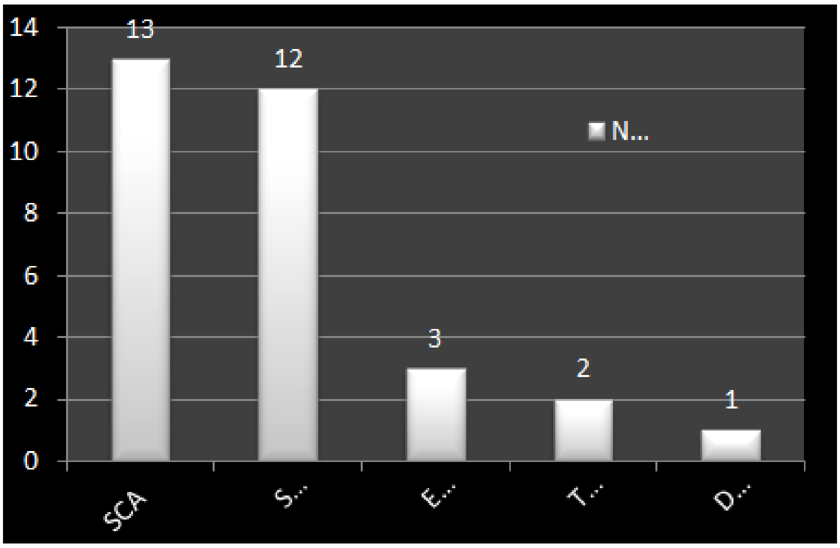

Fig-1: Distribution of cerebellar disorder in caes (n=30)

Sca-spinocerebellar ataxia

Table-1: Calculation of sensitivity and positive predictive value and of each cerebellar sign

Sign	Cases	Control	Total
Present	True positive (TP)	False positive (FP)	TP+FP
Absent	False negetive (FN)	True negative (TN)	FN+TN
Total	TP+FN	FP+TN	

Sensitivity = tp /tp+fn

Positive predictive value (ppv) = TP/TP+FP

By putting the value in above table sensitivity and ppv of each cerebellar sign can be calculated

Table-2: Sensitivity and positive predictive value of each cerebellar sign in cases (n=30)

S.NO	Cereberrar sign	Sensitivity (%)	PPV (%)
1	Nystagmus	36.66	100
2	Dysarthria	80	100
3	Dysmetria	56.66	100
4	Dysdiadochokinesia	83.33	100
5	Intention tremor	93.33	100
6	Ataxic-gait	93.33	100
7	Tandem walking	96.66	90.62
8	Hypotonia	6.66	100
9	Pendular knee jerk	3.33	100
10	Rebound phenomenon	46.66	100
11	Finger-nose test	66.66	100
12	Knee-heel test	63.33	100

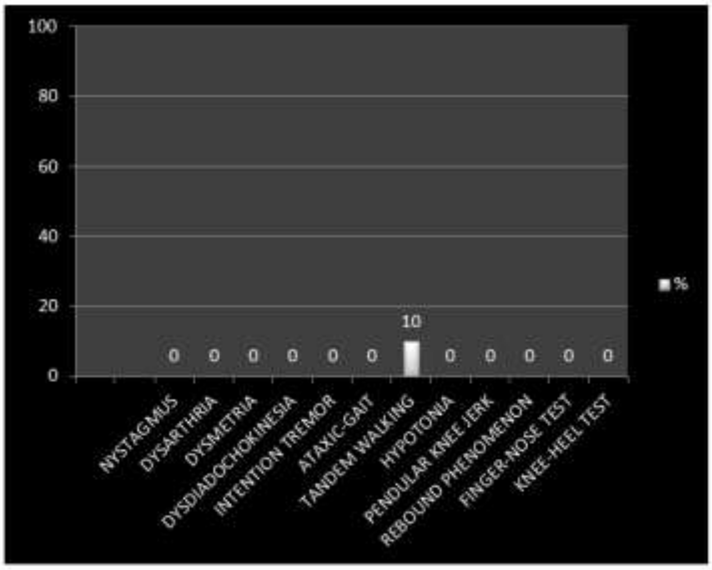

Fig-2: Sensitivity of cerebellar sign in control (n=30)

Table-3: Sensitivity's' value and confidence interval of 95%of each cerebellar signin cases (n=30)

S.NO.	Cerebellar sign	Senstivity %	'p'value%	C.I. OF 95%
1	Nystagmus	36.66	0.01<	0.180-0.545
2	Dysarthria	80	0.01<	0.593-0.905
3	Dysmetria	56.66	0.01<	0.358-0.726
4	Dysdiadochokinesia	83.33	0.01<	0.630-0.927
5	Intention tremor	93.33	0.01<	0.748-0.982
6	Ataxic-gait	93.33	0.01<	0.748-0.982
7	Tandem walking	96.66	0.01<	0.661-0.938
8	Hypotonia	6.66	0.472	-0.057-0.213
9	Pendular knee jerk	3.33	1.00	-0.083-0.167
10	Rebound phenomenon	46.66	0.01<	0.267-0.639
11	Finger-nose test	66.66	0.01<	0.455-0.808
12	Knee-heel test	63.33	0.01<	0.422-0.781

C.i.-confidence interval

DISCUSSION

Although the specific neurologic signs associated with cerebellar disease and injury is numerous4, the basic functional deficits producing these signs are relatively few. Moreover, these basic functional deficits are a logical consequence of the disruption of the motor functions known to be carried out by the cerebellum.

The cerebellar modulation and coordination of muscular activity are important in skilled voluntary movement, as well as in the movements of posture and equilibrium.

Destruction of small portions of the cerebellar cortex rarely causes detectable abnormalities in motor function. To cause serious and continuing dysfunction, the cerebellar lesion must be extensive and usually involves one or more of the deep cerebellar nuclei in addition to the cerebellar cortex. It is interesting that the neurologic signs produced even by extensive damage tend to gradually diminish with time, assuming that the underlying disease process does not itself progress. Such improvement is particularly evident following childhood damage. In experimental animals, even after as much as 50% of the cerebellar cortex has been removed, if the deep nuclei are left intact, motor function appears normal as long as the movements are performed slowly.

There is need for more of scientific studies on the validity of traditional neurological teaching of clinical sign. But what the evidence base for above mention statements? A thorough search in the literature did not found the incidence of these cerebellar signs in cerebellar disorder and there validity, that is why I had performed that study for validity of these conventional cerebellar signs.

I study the patients of cerebellar disorder in Jayarogya Hospital, Gwalior India from sept- 2016 to sept.2017 and following results are demonstrated;

Figure n.o1 showing various disorder of cerebellum which are under consideration in which maximum patients are of spinocerebellar ataxia(SCA) and stroke and remaining are of eptoin toxicity,tuberculoma and stroke. *Table no.1* how we calculate the sensitivity, and positive predictive value

Table no.2 this table showing the sensitivity, and positive predictive value of each cerebellar sign in cases. The sensitivity of these signs in decreasing order as;

Tandem walking (96.66%) > Ataxic-gait (93.33%)= intention tremor (93.33%) > dysdiadochokinesia (83.33%) > dysarthria(80%) > finger-nose test(66.66%) > knee-heel test (63.33%) > dysmetria(56.66%) > rebound phenomenon (46.66%) > nystagmus(36.66%) > hypotonia (6.66%)> pendular knee jerk(3.33%).

Inability to do Tandem Walking test have the maximum sensitivity (96.66%) means 96.66% of cases of cerebellar disorder can't able to perform Tandem Walking, and pendular knee jerk have the minimum sensitivity (3.33%).

All the cerebellar signs except Tandem walking (90%) have 100% specificity, means these signs are not demonstrated in normal healthy individual. But inability to do Tandem walking can be demonstrated in elderly normal individual who have no evidence of cerebellar involvement.

All the cerebellar signs except Tandem walking (90.62%) have 100% positive predictive value, it means if these signs are present in individual than chances of patients having cerebellar disorder are very high. *Figure no.2* showing the prevalence of cerebellar signs in control

All cerebellar signs are absent in control subject except Tandem walking. Out of these 30 control subject 3 individual are unable to perform tandem walking .so the prevalence of all cerebellar signs except Tandem walking in control subject is zero, the prevalence of Tandem walking in control subject is 10%.

These 3 control subject which having impaired Tandem walking were elder, one was 65 year, and two was 75 year old, none of them having any medical illness. The probable reason for impaired Tandem walking in older person can be explained by;

Gait disorders may occur for a number of reasons, and most are non-neurological in origin. Joint pain, muscle weakness, deformities, blindness, vestibular dysfunction, psychological factors, poorly fitting shoes (especially in those with edema and bunions) and deconditioning all may play role.

Table no. 3 showing the sensitivity, p value and c.i. (confidence interval) of each cerebellar sign in cases, All of these signs having significant 'p' value ($p<0.01$) except hypotonia($p=0.472$) and pendular knee jerk($p=1.00$).

Out of 30 cases only 2 study subjects having hypotonia , and these two subjects were cases of acute eptoin or phenytoin toxicity.

although this test is statistically not significant but this is for chronic cerebellar disorder because with time hypotonia is recovered and in cases of acute cerebellar injury hypotonia is persist and significantly found , in this study there were only 3 cases of acute cerebellar injury , so that might be the probable explanation why hypotonia is statistically not significant.

STATISTIC METHODE USED IN THE STUDY

The 'P' value is calculated by applying *Pearson's chi-square Test with Yates's correction.* The software used is WINPEPI.

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