ORIGINAL ARTICLE

IMPACT OF CEREBRAL PALSY ON HAND PREFERENCE WITH SPECIAL REFERENCE TO PREMATURE BIRTH

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Abstract

Aim: To evaluate the incidence of left handedness amongst the cases of cerebral palsy (CP) and to investigate the association between prematurity and hand preference.

Material & Methods: The present study is an out come of a camp 'LIFE LINE' organized at Jabalpur for developmental disorders. A total of 118 CP cases also attended the camp. Cohort of 113 CP cases was considered for evaluation of the hand preferences and its relationship with prematurity. The Edinburgh Inventory with local adjustment was used to asses the hand preference of the subjects. The parental interview pertaining to handedness of parents and children, past history, family history and relevant demographic information were also recorded.

Results: The mean age of the studied subjects was 6.2 $\pm$ 2.5 years, male: female ratio was 1.26:1. Diplegia (71.7%) was the most common type of the CP followed by hemiplegia (14.2%), quadriplegia (8%) and extrapyramidal CP (5.3%). More than half (51.3%) of the cases were found left handed on the Edinburgh method of evaluation as well as on their parental perception. The incidence of left handedness among the cases of CP was considerably higher than the reported prevalence of left handedness (10%) among the general population. Interestingly nearly one-fifth of the studied subjects (18.6%) were preterm and out of these a significantly higher proportion (71.4%) was found with left handedness preference. (p=0.041).

Conclusion: We have observed higher probabilities of sinistrality in cerebral palsy cases compared with the general population. The probable explanation of this could be the damage to the left hemisphere which causes a mild hypofunction of the contralateral hand (in neutral right handers) which results the child to switch over to the opposite hand (left hand) for activities.

Key words: Cerebral Palsy, Left handedness, prematurity.

Introduction

Cerebral palsy (CP) is a static encephalopathy. It is a disorder of posture and or movement. It is defined as an "umbrella" term covering a group of non progressive but often changing motor impairment syndromes secondary to lesions or anomalies of the brain arising in the early stages of its development. (1) Periventricular leukomalacia is a major neuropathological substrate underlying most of the neurologic morbidity in cerebral palsy. Etiopathogenesis of periventricular leukomalacia is believed to be multifactorial, involving hypoxic-ischemic insults and inflammatory processes. (2) Prematurity is a major contributor to increasing incidence of hypoxic ischemic encephalopathy. Fragile blood vessels in the periventricular area predisposes to ischemic as well as hemorrhagic in-utero insults.

Over years, the left handedness has been linked to variety of undesirable personal characteristics including criminals, juvenile delinquents, people with behavioral disorders, aggressive tendencies, speech and reading problems and mental retardation. (3) Left-handers comprise almost 28% of the severely and profoundly mentally retarded population. It is believed that in these individuals, both their left-handedness and their retardation are caused by brain damage to their left hemisphere as a result of a prenatal or postnatal event. (3) Premature birth has been shown to be associated with left hand preference. (4) There is no genetic component to this type of left-handedness. The second type of left-handedness is the natural or genetic left-handedness. Such persons function normally and have no association with any pathological process. The third type of left-handedness is the learned left-handedness.

Our study is based on incidence of pathological left handedness in children with perinatal/ postnatal brain damage manifesting as motor anomalies and being classified in the criteria of cerebral palsy. The aim of our study is to find a correlation between left handedness and cerebral palsy. The objective of our study was to evaluate the prevalence of handedness (left/right) amongst the cases of cerebral palsy and to investigate the association between prematurity associated cerebral palsy and hand preference.

Materials and Methods

A study was conducted at NSCB Medical College Jabalpur, spinal injury centre lifeline camp which catered to the patients of developmental anomaly and cerebral palsy. The duration of the study was from 1st May 2009 up to 10th June 2009. A total of 113 patients were examined and evaluated by a team of specialists and were classified as per the Swedish classification. (5) The Edinburgh Inventory (6) with local adjustment was used to assess the hand preference of the subjects. It was based on assessment of hand preference for certain tasks - writing , drawing, throwing, using spoon, using scissors, striking a match and opening bottle lid. Edinburgh Inventory was also applied on the parents to find a genetic correlate between the handedness of parents and children. The parental interview pertaining to handedness of parents and children, past history, family history and relevant demographic information were also recorded. Relevant birth history like gestation age of the child at the time of delivery was obtained to find out a correlation between prematurity and handedness.

Results

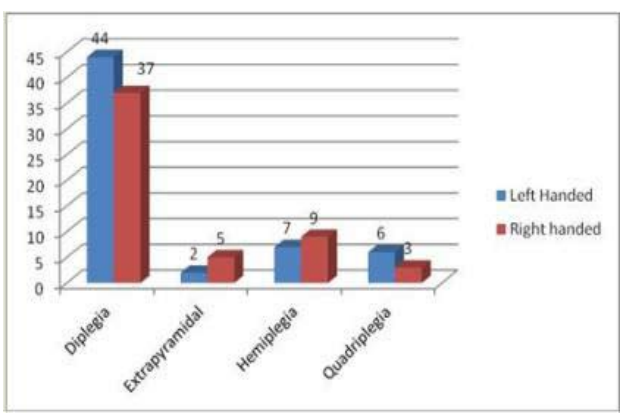
The mean age of the studied subjects was 6.2 $\pm$ 2.5 years with a median age of 5 years 11months. Male - female ratio was 1.26:1. In our study, 113 patients were examined out of which 81 (71.7%) patients were diplegic, 9 (8%) were quadriplegic, 16 (14.2%) were hemiplegic and 7(6.1 %) ataxic. Fifty-

Table 1: Handedness of parents and the patients

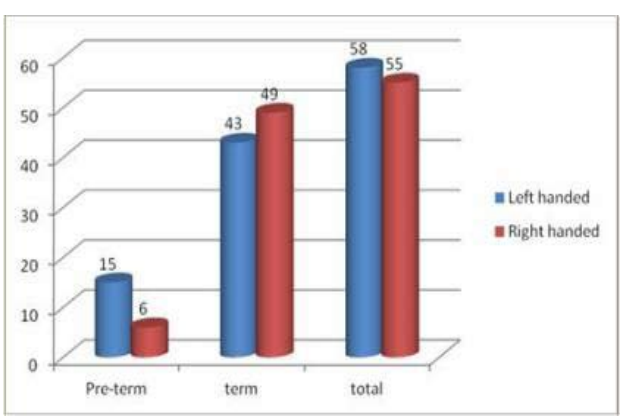
Handedness of father	Handedness of mother	No. of patients (right handed)	No. of patients (left-handed)	Total
Right	Right	45 (39.8%)	43 (38.1%)	88
Right	Left	6 (5.3%)	7 (6.2%)	13
Left	Right	4 (3.5%)	7 (6.2%)	11
Left	Left	0	1 (0.9%)	1

eight (51.3%) of the cases were found left handed on the Edinburgh method of evaluation as well as on their parental perception of which 43 patients had right handed parents. Table 1 depicts handedness of the parents among these CP patients. Figure 1 depicts handedness among various types of CP. Twenty one patients (18.6%) were preterms and out of these 15 (71.4%) were found with left handedness preference (p=0.041) (Figure 2).

Graph 1: Handedness among different types of CP



Graph 2: Handedness and gestational age



Discussion

The results thus obtained can be deciphered as either there is increased incidence of cerebral palsy in the left handed individuals or that cerebral palsy patients show pathological left handedness in increased frequency. If family sinistrality (genetic left handedness) is a risk factor for brain damage, then parents of cerebral palsy patients should be more than usual sinistrals. (7,8) In addition, more severe the probands' retardation the greater should be the probability of left handers among the parents. (9,10) Most of parents were right handed even in that case the children with cerebral palsy had equal representation of right and left hand dominance which is significantly higher than normal genetic predisposition of left hand dominance of approximately 10% in general population thus proving that genetic left handedness is not a risk factor for cerebral palsy. In order to directly identify the pathological left handedness, the studies must rely on the inference based on statistical analysis. For instance if a particular neuro-pathological population like cerebral palsy incorporates a significantly higher proportion of left handers than is found in their parents , the excess of left handedness in the given sample under study could be made up of pathological left handed people. The explanation of this increase in manifest left handedness in the brain injured groups postulate that the damage to the left hemisphere causes a mild hypofunction of the contralateral hand (in neutral right handers) which in turn causes the child the switch to the opposite hand (left hand) for manual activities. (11)

Extent and location of brain damage differs on the basis of gestation age between term and preterm cases of cerebral palsy, sub-cortical white matter damage being more common in preterm cases compared to those born at term. This difference in topography and magnitude of brain damage may be the possible cause of significant difference in the left handedness in preterm and term cases of cerebral palsy. (12,13) The authors suggest further in-vivo study is required to concretely prove the apparent inclination towards the left handedness.

According to the authors increased incidence of dominant hemisphere damage could be because of variation in the expression of eNOS (endothelial nitric oxide synthase) and iNOS (inducible nitric oxide synthase) in left and right hemispheres of the brain. Expression of eNOS is more in the right hemisphere compared to iNOS expression which is more in the left hemisphere. iNOS has been shown to be neurodegenerative whereas eNOS has a neuroprotective effect. eNOS plays an important role in the control of cerebral blood flow, metabolism, and, in turn, neuronal activity. (14, 15) Mice with a disrupted

eNOS gene are hypertensive and exhibit a reduction in cerebral blood flow, which could favor cerebral ischemia. (14, 15)

Our study of 113 patient of cerebral palsy showed significant association between cerebral palsy and left handedness. This study needs to be substantiated with a bigger study to prove the association and prove the significance of our finding.

Our study hypothesizes that the dominant hemisphere of the brain is damaged to a greater extent than the non dominant hemisphere, so we suggest that the functions controlled by the nondominant hemisphere of the brain (visuospatial information, nonlinguistic sounds i.e. music touch sensation) should be reinforced by proper vocational training. (16) Further studies are required to strengthen our assumptions.

Conclusion

In our study we have shown that there is gross disparity in the occurrence of sinistrality in the patients of cerebral palsy as compared to the general population. This data supports the authors' view of existence of pathological left handedness in the patients of cerebral palsy. This could be due to greater extent of damage to the dominant hemisphere in an event of global hypoxic ischemic encephalopathy and subsequent migration of function of hand dominance to the right hemisphere. Study clearly demonstrated a significant difference in the manifestation of handedness in the cases of premature cases compared to those born at term.

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