Original Article

Neuro-imaging findings in children with developmental delay and cerebral palsy: experience from a tertiary medical center of Bangladesh

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ABSTRACT

Background: *Cerebral palsy (CP) is the most common developmental disability in children. Neuro-imaging in CP is widely used investigation. Imaging study can visualize the anatomical location of lesion in brain. The aim of this study was to find out the extent of non-progressive damage in brain among children with CP.*

Methods*: This was a cross-sectional study. Data were collected from the out-patient department of Institute of Pediatric Neurodisorders & Autism (IPNA), Bangabandhu Sheikh Mujib Medical University (BSMMU) from December, 2019 to March, 2020.*

Results*: Total 88 cases (age up to 14 years) were reviewed. There was male predominance and male to female ratio was 2:1. Computed tomography (CT) scan was done in majority of patients (71 cases) and magnetic resonance imaging (MRI) in 17 cases. Major abnormalities were atrophy in 34.1% cases, ventricular dilatation in 14.8% cases, encephalomalacia in 19.3% cases and basal ganglia lesion in 11.4% cases. Overall in CT scan group, 95.77% cases were abnormal and in MRI group, 88.23% were abnormal.*

Conclusion*: Atrophy of the brain was the most common finding in neuro-imaging of patients with CP and developmental disabilities. Neuro-imaging is very useful and recommended for the children with developmental delay and CP cases. It may help to classify the CP and may give a clue for further investigations such as metabolic screening and genetic testing.*

Key words*: cerebral palsy, neuro-imaging.*

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INTRODUCTION

Cerebral palsy (CP) is a static injury to the developing or immature brain during the process of birth. The global incidence of CP is 2 per 1000 live births.[1] A pilot study showed the prevalence of CP in Bangladesh was 3.7 per 1000 live births that is higher than developed countries.[2] Depending upon the perinatal damage or insult, children present with developmental delay. The more severe the insult, more early is the presentation. The American Academy of Neurology and the Practice Committee of Child Neurology Society developed a practice parameter in 2004 and recommended neuro-imaging study in CP cases of unknown etiology.[2]We compiled the history, clinical presentation and imaging reports of developmental delay and CP children. Though computed tomography (CT) scan is less sensitive and specific test than magnetic resonance imaging (MRI), still both were considered.[3] The aim of the study was to find out the extent of non-progressive damage in brain among children with CP.

METHODS

It was a descriptive cross-sectional study. Total 88 cases (age up to 14 years) of developmental delay and CP cases were reviewed. The cases were collected from the outpatient department of Institute of Pediatric Neurodisorder& Autism (IPNA) of Bangabandhu Sheikh Mujib Medical University(BSMMU) from December, 2019 to March, 2020.

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At first history taking, physical examination, type of delay or type of CP was assessed by the researcher. Neuro-imaging was advised or previous report (done within the previous7 days of data collection) was collected. Imaging study were reviewed by expert neuro-radiologist. All cases were enrolled who had developmental delay and CP with neuro-imaging study. Cases with inflammatory diseases, vasculitis, tumor and autism were not included in this study.

Statistical analysis

To analyze the data, Statistical Package for Social Science (SPSS) version 22.0 was used. After entry, range and consistency was checked. Statistical analysis was done by using descriptive statistics. Continuous variables were presented as mean values ± standard deviation (SD) and categorical variables were presented as percentages. Probability of <0.05 was considered as statistically significant and their 95% confidence intervals (CI) were also equated.

Ethical consideration

The purpose and procedure of the study were properly explained to the parents/guardian and informed written consent was taken from them. The study did not involving any additional burden to the patients. All participants in a research study had a right to have the information that they provided to be kept confidential.

RESULTS

Total 88 children came with developmental delay. Age distribution of the patients is shown in Figure 1. There was male (n=59) predominance and male female ratio was 2:1. About 86.4% were full term infant, 11.4% were preterm infant and 2.2% were small for gestational age. Majority of the infants (63.6%) were born at hospital and 36.4% were born at home. History of delayed crying or definite perinatal asphyxia was present in 58% cases and no history of asphyxia in 42%. In this case series, 18.2% were positive for congenital cytomegalo virus (CMV) infection.Majority (32, 36.36%) came within 6 months to 12 months of age. So, definite developmental delay was found in 30.7% children and by further follow-up and with time, we can classify the type of CP. While classifying the CP types, we found 24% had spastic quadriplegia, 13.6% had dystonia, 17% had mixed CP, 8% had hemiplegic CP and 3.4% had hypotonic CP (Table I).

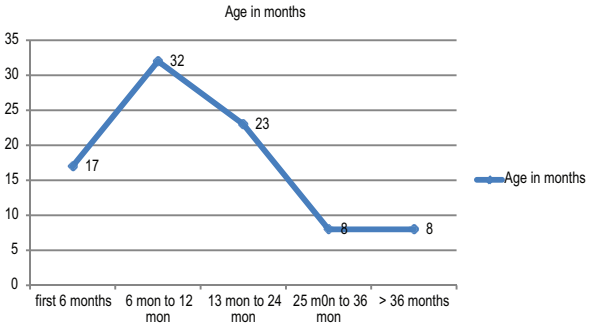

Figure 1 Age distribution of the study participants (N=88)

Table I Types of cerebral palsy (N = 88)

Sl No	Type	Frequency	%
1.	Developmental delay	27	30.7*
2.	Spastic quadriplegia	21	23.9*
3.	Dystonia	12	13.6
4.	Mixed	15	17.0
5.	Hemiplegia	7	8.0
6.	Hypotonia	3	3.4
7.	Spastic diplegia	2	2.3
8.	Choreoathetoid	1	1.1
9.	Total	88	100.0

We reviewed total 71 CT scan and 17 MRI reports. In CT scan group, 95.77% records were abnormal and in MRI group 8.2% records were abnormal. There was no detectable neuronal loss or structural damage in spite of asphyxia.

Considering grey matter (GM) injury (Table II), we found encephalomalacia in 19.3% (Figure 2A), cerebral atrophy in 34.1%, basal ganglia hyperintensity in 11.4% and thalamic hyperintensity in 5.7% cases. Here atrophy was prominent finding in majority of the cases and second common finding was encephalomalacia.

Table II Type of injury in grey matter

Name	frequency	%
Normal	26	29.5
Basal ganglia calcification/hyperintensity	10	11.4
Encephalomalacia	17	19.3
Thalamic hyperintensity	5	5.7
Atrophy	30	34.1*
Total	88	100

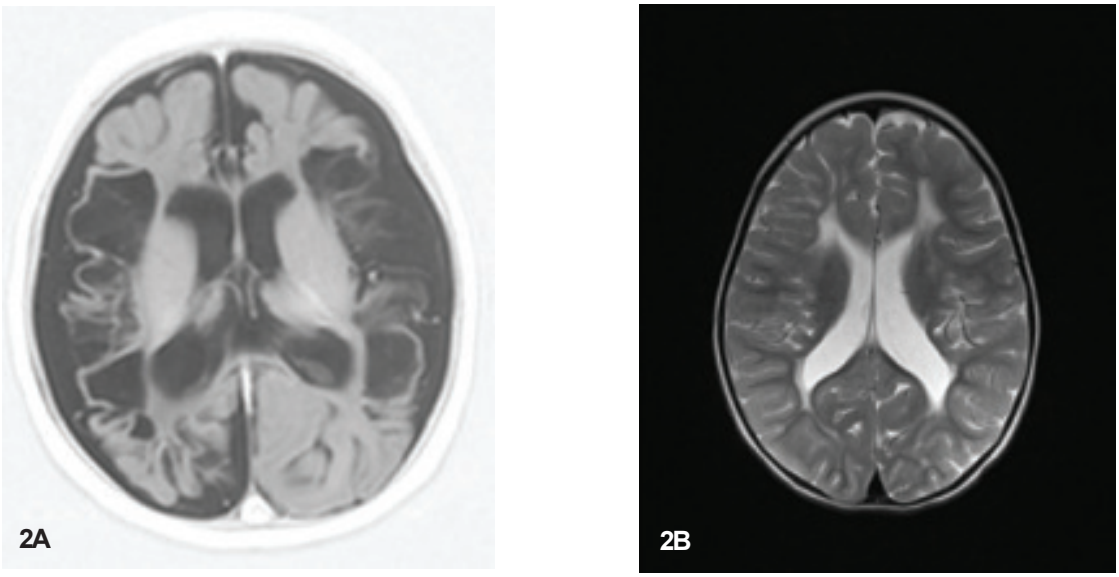

Figure 2 MRI of brain, coronal sections showing (A) multicysticencephalomalacia (T1 weighted image), (B) Periventricular leucomalacia (PVL) (T2 weighted image)

In this study, white matter (WM) injury was in only 20.5% cases. Most common finding was periventricular leucomalacia and calcification in 6.8% respectively (Figure 2B). About 3.4% had intraventricular hemorrhage and subdural hematoma (Table III). Less common finding was hydrocephalous. Ventricular dilatation was seen in 14.8% and acquiductal stenosis in 1.1%. Structural malformation was found in 10% cases. We observed absence of corpus callosum (2.3%), thin corpus callosum (3.4%), holoporencephaly (1.1%), schizencephaly (2.3%), and cerebellar atrophy (1.1%).

Electroencephalography (EEG) was done for active and suspected seizures. As we know epilepsy is one of the common comorbidity in cerebral palsy cases. We found epileptic encephalopathy in 26.1%, focal epileptiform discharges in 20.5% and multifocal in 11.4% which were significantly associated with spastic quadriplegia ($p<0.05$) (Table IV). EEG showed no abnormality in 16% case. Epileptic encephalopathy, multifocal and focal epileptiform discharges are present in spastic quadriplegia and mixed type of CP.

Table III Type of injury in white matter

Name	Frequency	%
Normal	70	79.5
PVL	6	6.8*
IVH	3	3.4
Subdural hematoma	3	3.4
PV calcification	6	6.8*
Total	88	100

NB: PVL (periventricular leucomalacia), IVH (intraventricular hemorrhage), PV (periventricular calcification)

Table IV Association between electroencephalography with types of cerebral palsy

EEG finding	No	Spastic Quadriplegia	Spastic diplegia	Hemiplegia	Hypotonia	Mixed	Choreoathetoid
Normal study	5	0	2	0	0	2	1
Focal discharges	6	5*	1	0	0	2	0
Multifocal discharges	4	2*	0	0	0	3*	0
Epileptic Encephalopathy	7	8*	1	0	0	5*	0
Diffuse ehyncephalopat	0	0	1	0	0	0	0

*P=0.00(P<0.05)

DISCUSSION

Among developmental delay and CP patients, majority was male, about 77%.[8,9]Majority was full term at birth about 86.4%and 11.4% were preterm. In our subcontinent, term infants were more in number where as studies from developed countries preterm was higher in number.[4] In this study, 36.4% were born at home and hospital delivery was higher in number. In study by Singhi and Aggarwal showed higher number of home delivery in their study; 58% had suffered from perinatal asphyxia after birth. Overall perinatal asphyxia is the most common cause for developing CP.[4] Considering the age at first reporting was within 6-12 months and 36.36% with developmental delay came during this age. While categorizing CP, most common motor problem was spastic quadriplegia. [4]Hemiplegic CP was found in 8% which is compatible with the finding of Prasad R.[10]

As neuro-imaging is an important diagnostic tool and it can be performed wherever is necessary. Here CT scan was more common than MRI. The reason behind is that, cost of MRI and children needs sedation which is not available in many centers.

Though MRI is superior to CT scan but definite lesion or structural damage was observe using CP scan. Similar finding was reported by Towsley and Shevell.[10] CP with normal imaging study needs metabolic screening as recommended in other studied.[9]Both GM and WM lesions are due to perinatal insult though 42% had no definite h/o asphyxia. Diffuse grey matter lesion i.e. encephalomalacia were seen in 19.3 %, deep GM lesion was found in 17.1% and atrophy in 34.1% Periventricular white matter lesion was found in 13.6%. This is consistent with Prasad and Shevell.[9,10] Basal ganglia lesion was found in 11.4% and somewhat similar results were found by Prasad. [9]We found cerebral malformation in 8%.[9]

Association between EEG findings and types of CP had showed statistically highly significant. Abnormal EEG was found in spastic quadriplegia, spastic diplegia and mixed CP group.[3,9]

Conclusion

Common imaging findings in this study were atrophy, ventricular dilatation, encephalomalacia and basal ganglia lesion. Neuro-imaging appered as important investigation tools for patients with CP and developmental delay. Neuro-imaging is important for diagnosis and to see the extent of damage caused by perinatal insult. We should consider imaging study especially CT or MRI early in the course of illness.

Limitation of the study: It was a small scale research and neuroimaging couldnot be done at very early age.

Authors' contribution: NN and JS developed the original idea and the protocol, abstracted and analyzed data, wrote the manuscript. SA reviewed the manuscript. All authors read and approved the final manuscript.

Conflict of interest: Nothing to declare.

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