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Original article:

Study of correlation severity of hypoxic ischemic encephalopathy on MRI brain with clinical findings

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Abstract:

Introduction: MRI is the imaging modality of choice for the diagnosis and follow-up of infants with hypoxic-ischemic encephalopathy (HIE).

Materials and methods: A Hospital based prospective study of 101 cases of diagnosed/suspected HIE patients with findings in clinical variables and imaging studies

Results: Total population was divided into 3 groups. Maximum number of children were in the <1 month age group constituting 56(55.44%), followed by the age group 1 month upto 1 year constituting 44 (43.56 %) of the children.

The youngest patient was 1 day and eldest was 1 year 9 month.

Maximum no of patients were less than 1 month and the average age of patient in the study is 2.96 month.

Conclusion: MRI is the investigation of choice in suspected/known patients of hypoxic ischemic encephalopathy and it is also useful for follow-up.

Introduction:

MRI is the imaging modality of choice for the diagnosis and follow-up of infants with hypoxic-ischemic encephalopathy (HIE).[1,2] Conventional MRI sequences (T1 and T2) provide information on the status of myelination and preexisting developmental defects of the brain.

When performed after the first day (and particularly after day 4), conventional images may accurately demonstrate the injury pattern as area of hyperintensity. Conventional images are most helpful at age 7-10 days, when the diffusion-weighted imaging (DWI) findings have pseudonormalized. Following a severe asphyxial event, a central pattern of injury is seen with injury to (1) the deep gray matter (i.e., putamina, ventrolateral thalamus, hippocampi, dorsal brainstem, or lateral geniculate nucleus) and (2) the perirolandic cortex.

These areas contain the highest concentration of N-methyl-D-aspartate (NMDA) receptors and are actively myelinating.

Materials and methods:

A Hospital based prospective study of 101 cases of diagnosed/suspected HIE patients with findings in clinical variables and imaging studies.

Inclusion criteria:

MRI was done as a screening test.

Patients were selected on the basis of:-Patients were included in the study if they metall the following criteria:

(i) Pre term or term (37-43 week's gestation);

(ii) evidence of fetal distress;

(iii) neurologically abnormal in the first 48 hours of life, with abnormalities of tone with or without convulsions and altered consciousness. Fetal distress was diagnosed in the presence of cardiotocographic abnormalities of bradycardia (<100/minute or late decelarations(type II dips) with or without meconium stained liquor and with low Apgar scores and the necessity for resuscitation.

Hypoxic-ischaemic encephalopathy was classified as mild, moderate, or severe (I, II, or III) according to Sarnat and Sarnat."

Equipment:

MRI was performed on " PHILIPS ACHIEVA 1.5T" MACHINE.

Standard head coil & NV coil was used for imaging.

Observations and results :

Table No. 1 Association among the cases between-Pattern Of Involvement and Risk Factors

Pattern Of Involvement		Risk Factors				Total
		Neonatal #	Maternal #	Placental @	Not Known @	
Basal Ganglia Thalamus Pattern	No.	41	12	5	6	64
	%	64.1%	18.8%	7.8%	9.4%	100.0%
Periventricular Leucomalacia ^	No.	8	6	0	13	27
	%	29.6%	22.2%	0.0%	48.1%	100.0%
Multicystic Encephalopathy ^	No.	4	4	1	1	10
	%	40.0%	40.0%	10.0%	10.0%	100.0%
Total	No.	53	22	6	20	101
	%	52.5%	21.8%	5.9%	19.8%	100.0%

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Chi-Square tests	Value	df	p-value	Association is-
Pearson Chi-Square $	23.629	6	0.00061	**Significant**
Pearson Chi-Square ^	5.523	1	0.0188	**Significant**
$ 5 cells (41.7%) have expected count less than 5. ^, #, @ Row & Column data pooled & Chi-Square Test reapplied.				

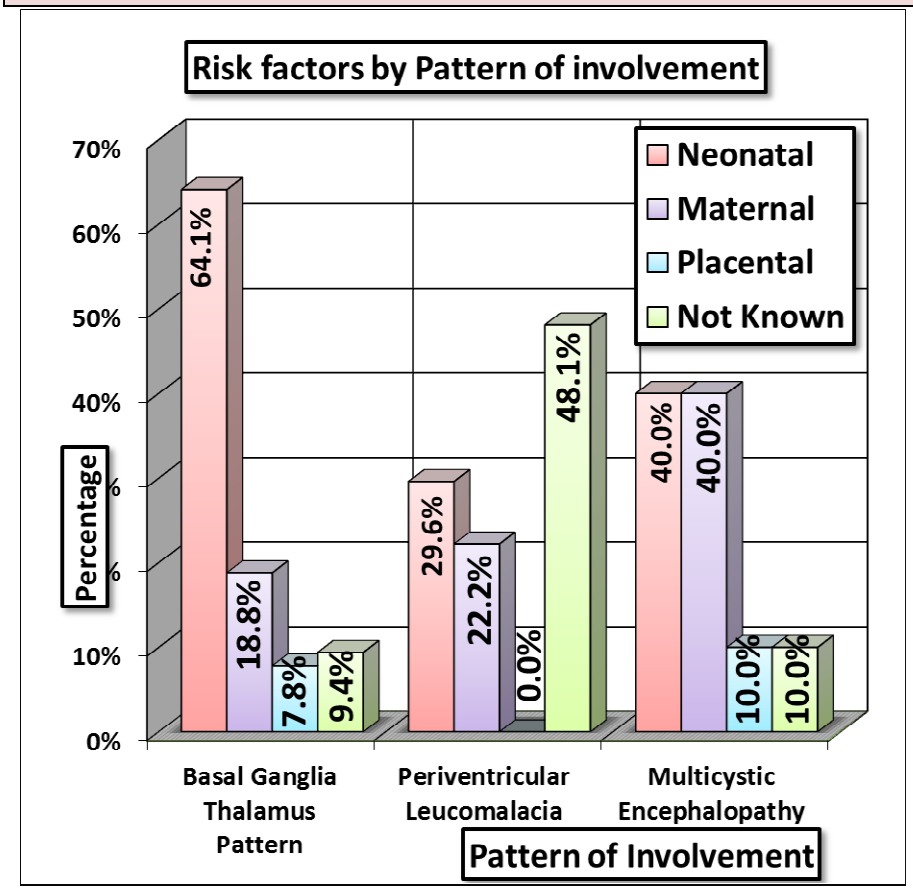

Table No. 2 : Association among the cases between-Pattern Of Involvement and Term of Pregnancy

Pattern Of Involvement		Term/ Preterm		Total
		Term	Preterm	
Basal Ganglia Thalamus Pattern	No.	54	10	64
	%	87.1%	25.6%	63.4%
Periventricular Leucomalacia	No.	5	22	27
	%	8.1%	56.4%	26.7%
Multicystic Encephalopathy	No.	3	7	10
	%	4.8%	17.9%	9.9%
Total	No.	62	39	101
	%	100.0%	100.0%	100.0%

Chi-Square tests	Value	df	p-value	Association is-
Pearson Chi-Square	39.357	2	2.84E-09	Significant

Table No. 3: Association among the cases between-Pattern Of Involvement and Apgar Score

Pattern Of Involvement		Apgar Score			Total
		<= 3	4 to 7	> 7	
Basal Ganglia Thalamus Pattern	No.	15	20	29	64
	%	23.4%	31.3%	45.3%	100.0%
Periventricular Leucomalacia ^	No.	0	15	12	27
	%	0.0%	55.6%	44.4%	100.0%
Multicystic Encephalopathy ^	No.	1	4	5	10
	%	10.0%	40.0%	50.0%	100.0%
Total	No.	16	39	46	101
	%	15.8%	38.6%	45.5%	100.0%

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Chi-Square tests	Value	df	p-value	Association is-
Pearson Chi-Square $	9.786	4	0.04419	**Significant**
Pearson Chi-Square ^	8.818	2	0.012	**Significant**
$ 4 cells (44.4%) have expected count less than 5. ^ Row data pooled & Chi-Square Test reapplied.				

Table No.11 : Association among the cases between-Pattern Of Involvement * Sernat & Sernat Staging

Pattern Of Involvement		Sernat & Sernat Staging			Total
		1	2	3	
Basal Ganglia Thalamus Pattern	**No.**	13	32	19	64
	%	20.3%	50.0%	29.7%	100.0%
Periventricular Leucomalacia ^	**No.**	23	4	0	27
	%	85.2%	14.8%	0.0%	100.0%
Multicystic Encephalopathy ^	**No.**	4	4	2	10
	%	40.0%	40.0%	20.0%	100.0%
Total	**No.**	40	40	21	101
	%	39.6%	39.6%	20.8%	100.0%

Chi-Square tests	Value	df	p-value	Association is-
Pearson Chi-Square $	34.168	4	6.88E-07	**Significant**
Pearson Chi-Square ^	27.833	2	9.04E-07	**Significant**
$ 3 cells (33.3%) have expected count less than 5. ^ Row data pooled & Chi-Square Test reapplied.				

DISCUSSION

Total population was divided into 3 groups. Maximum number of children were in the <1 month age group constituting 56(55.44%), followed by the age group 1 month upto 1 year constituting 44 (43.56 %) of the children.

The youngest patient was 1 day and eldest was 1 year 9 month.

Maximum no of patients were less than 1 month and the average age of patient in the study is 2.96 month.

In the study 62(61.4%) were born at the term and 39(38.6%) born the preterm patients.

In the present study, HIE patients were categorized into 3 MRI patterns of CNS involvement and their percentages found to be as 1. Basal ganglia and thalamus involvement: 64 patients (63.4%), 2. Periventricular leukomalacia: 27 patients (26.7%), 3. Multicystic encephalopathy 10 patients (9.9%).

Basal ganglia–thalamus pattern (BGT) predominantly affects bilaterally the central grey nuclei (ventrolateral thalami and posterior putamina) and perirolandic cortex. Associated involvement of the hippocampus and brain stem is not uncommon. This pattern of injury is most often seen following an acute sentinel event, for instance a ruptured uterus, placental abruption or a prolapsed cord, and is also referred to as a pattern following 'acute near total asphyxia' .[3,4,5] Using conventional MRI, it was first shown by Rutherford et al.[114]that absence of a normal high-signal intensity of the posterior limb of the internal capsule (PLIC) is highly predictive of severe adverse sequelae. Using conventional MRI, an inversion of the signal within the PLIC is only seen from 48 to 72 h onwards. When MRI is performed early, DWI will already show changes in the basal ganglia/thalami. More accurate information about timing of injury can sometimes be obtained when measuring the apparent diffusion coefficients, but due to evolution over time, this is mainly helpful in the most severely affected infants, who have an MRI performed within the first few days after birth[5,6]. Hunt et al.[117]measured ADC values within the PLIC in 28 term infants with a clinical diagnosis of hypoxic–ischaemic encephalopathy (HIE) at a mean age of 5.6 days. ADC values were significantly associated with survival and motor outcome. Measuring fractional anisotropy (FA) was noted to be superior to measuring ADC values in predicting outcome [7]. While reduced ADC values were only found in infants with severe encephalopathy, reduced FA values were found in infants with severe and moderate encephalopath8. Children with the BGT pattern of injury tend to be severely disabled due to dyskinetic cerebral palsy (CP). **Himmelmann et al**.[9] studied 48 children at a mean age of 9 years (range 4–13 years) with dyskinetic CP mostly due to BGT injury and found that most children had Gross Motor Function Classification System levels of level IV, n=10, and level V, n=28. The rate of learning disability (n=35) and epilepsy (n=30) increased with the severity of the motor disability.

Multicystic encephalopathy : although not very common, severe involvement of the subcortical white matter and cortex can be seen with relative sparing of the immediate periventricular white matter and central grey matter, referred to as the

'white cerebrum', as DWI shows an almost completely white cerebrum, contrasted to a normal looking cerebellum[10] This condition tends to be fatal, but in case of survival, muticystic encephalomalacia will develop. An association was recently shown with homozygosity for the 677C>T[11] allele. The prevalence of

the 677C>T allele was studied in 11 children with HIE, their respective mothers and 85 healthy individuals. Seven mothers were homozygous and four heterozygous for the 677C>T allele. Five of the children were homozygous and six heterozygous for this polymorphism. The variant allele frequency was higher in the group of mothers with affected children than in the controls and was associated with an increase in plasma homocysteine after methionine loading. The 677C>T mutation in mothers, either in a homozygous or heterozygous state, together with poor nutritional status (probable folate deficiency) may represent a risk factor for irreversible brain injury in the offspring.

CONCLUSION

MRI is the investigation of choice in suspected/known patients of hypoxic ischemic encephalopathy and it is also useful for follow-up.

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