IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 14, Issue 12 Ver. IX (Dec. 2015), PP 21-25
www.iosrjournals.org

Magnetic Resonance Imaging of Brain in Neonatal Seizures

Dr.Snehalatha Gopu[1], Dr.Ravikumar Nalli[2], Dr.Sikha Maria Siromani[3]
[1.] *Assistant professor of Pediatrics, Niloufer hospital, Hyderabad, India*
[2.] *Associate professor of Pediatrics, Niloufer hospital, Hyderabad, India*
[3.] *Assistant professor of Pediatrics, Niloufer hospital, Hyderabad, India*

Abstract:
Background*: Neonatal magnetic resonance imaging (MRI) is a relatively new technique which has rapidly became the study of choice for the evaluation of central nervous system disorder in the newborn. MR imaging provides excellent anatomical depiction of the brain which surpasses intracranial ultrasound and computed tomography of brain. MR imaging is directed at understanding the prognostic implications of the CNS disease in newborn.*
Objectives*: To study is to know the MRI brain changes in neonatal seizures and to correlate type of seizure with MRI changes.*
Material and methods: *we conducted a hospital-based prospective observational study fromthe period of 2007 march to 2008 march in the department of paediatrics NICU, Gandhi hospital, Secunderabad. It included both preterm and term babies with seizures. Babies with inclusion criteria have under gone MRI imaging of brain under supervision of pediatric resident. Various MRI changes are recorded in both term and preterm neonates and correlated with clinical type of seizures.*
Results: *70 % neonates had abnormal MRI brain changes. All (13)32.5 % preterm babies had abnormal brain mri.30 %(12) term had normal brain MRI, 37.5 %(15) term babies had abnormal MRI. Most common abnormality found was perinatal hypoxic injury, was seen in 53.5% .40% term babies had moderate to severe asphyxial changes, 18%term babies had very severe insult.9% preterm babies had periventricular leucomalacia. Preterms with infection had infarction (22.2%) and hemorrhage (22.2%).15 % babies with abnormal MRI had subtle seizures, 37.5% babies with abnormal MRI had tonic seizures. There was significant association was found ($p<0.05$) between tonic seizures and abnormal MRI changes.*
Conclusion:*MRI brain detected markedly high incidence of brain lesions in 70% neonates with neonatal seizures.mri brain is indicated in all term babies with perinatal asphyxia and in all preterm babies with seizures irrespective of etiology where facilities are available to know extent of damage, for early interventions and for prognostification purpose in future.*
Key Words:*MRI brain, neonatal seizures, preterm babies, perinatal hypoxia, term babies.*

I. Introduction

Convulsion is one of the most common problems in the neonatal period. Neonatal convulsion has high mortality morbidity. Neurological examination, interictal EEG, Neuroimaging offer best predictor of outcome. Among the Neuroimaging techniques neonatal magnetic resonance imaging is rapidly emerging as the preferred modality for the evaluation of central nervous system disorders in the newborn. The multiple specialized MR sequences allow for greater sensitivity and specificity for the detection of parenchymal and extra axial process. In addition MR imaging is the only technique which can distinguish the presence or absence of myelin in the neonatal brain. While MR imaging does not use ionization radiation to acquire images such as in CT and plain radiograph. Radiofrequency pulses used to deflect the proton spins within the tissues for the various MR imaging sequences. With advent of MR compatible devices, even relatively unstable patient can be transported and monitored in the MR scanner. Neonatal MR imaging is rapidly becoming important in predicting neuro-developmental outcomes, and the future of MR imaging is directed at understanding the prognostic implications of the CNS disease in newborn. MR imaging is beginning to play an important role in developmental risk stratification in preterm and term neonates.Current technique in neonatal imaging allow for early detection of various neuropathological process including ischemic, hemorrhagic, metabolic, infectious states. Imaging abnormalities which appear to be most predictive of poor outcome include significant white matter injury and IVH with accompanied ventricular dilatation. A prospective cohort study by miller etal, the results of this study showed significant correlation between degrees of white matter injury, ventriculomegaly, IVH, found on early MRI found with severity with neurodevelopmental outcome[1].Woodward and colleagues studied that moderate to severe white matter abnormalities on MRI were found to be statistically strong predictors of cognitive and psychomotor delay, cerebral palsy, neurosensory impairment by 2 years of age.

II. Objectives

1. To study the MRI brain changes in neonatal seizures.
2. To correlate type of seizure with MRI changes

III. Materials And Methods

The present study is a hospital-based prospective observational study conducted in the department of nicu, Gandhi hospital, Secunderabad. It is done during the period of 2007 march to 2008 march. Study included both preterm and term babies with convulsions. The sample size consists, of 100 neonates admitted with convulsions in neonatal intensive care unit of Gandhi hospital. Out of 100 neonates with seizures, 40 are subjected to MRI of brain. Detailed history is taken regarding antenatal and natal period and detailed clinical examination of babies is done. Type of convulsion, time of onset and etiology of convulsion are noted.

Babies are subjected to initial investigations like hemoglobin, total white blood cell count, peripheral smear, random blood sugar, serum calcium & serum magnesium, S.electrolytes, blood culture and sensitivity. Neurosonogram and CSF analysis are done when ever required. Based on the clinical and laboratory data etiology of seizures is identified and grouped accordingly.

Excluding the neonates with metabolic seizures (hypoglycemia, Hypocalcemia, Hyponatremia, and hypomagnesaemia), ventilated babies and parents who did not give consent for MRI imageology, remaining all other neonates are subjected to MRI once their clinical condition is stable and informed consent is obtained from parents.

Neonatal seizures were diagnosed clinically and classified according to Volpe as: (1) subtle; (2) clonic; (3) tonic; and (4) myoclonic[2]. Infants diagnosed as having neonatal encephalopathy are graded by clinical severity according to Sarnat and Sarnat staging [3].

Based on the MRI abnormalities hypoxic ischemic encephalopathy babies are categorized as per Barkovich and Triulzi into 3 categories[4, 5].

A. Mild to moderate insult– primarily hypotensive injuries. Lesions are in the arterial watershed zones between major arteries (parasaggital pattern)

B. Sever insult– lesion are primarily seen in the lateral thalamus, posterior putamen, hippocampus, Perirolandic cortices.

C. More severe insult– diffuse cortical abnormalities

All infants were accompanied by a pediatric resident during MRI procedure and monitored with pulse oximetry. Most of the babies did not require sedation during the MRI imaging process. Only in few neonates sedation is obtained using i.v midazolam hydrochloride 0.1 mg/kg.there is no sedation failure and adverse reaction to drug noted.

IV. Results

1200 neonates are admitted during the year 2007-2008, 100 neonates are found to have neonatal seizures. Incidence of neonatal seizures is 8.3%.among 790 admitted male babies 69 male babies have seizures. Among 410 admitted female babies 31 female babies have seizures. There is no significant is found between the incidence of neonatal seizures in male babies and female babies ($p>0.05$). In present study, pre term babies with seizures accounted for 8.1% (44/540) and term babies with seizures accounted for 8.4 %(56/660).it is statistically not significant ($p>0.05$)(table1).

Table1. Distribution of cases based on gestation

	Number	Number of admissions	Percentage
Preterm	44	540	8.1
Term	56	660	8.4
Total	100	1200	

Out of 100 babies 53% had birth asphyxia, 21% had infection, 10% had hypoglycemia, 5% had hypocalcaemia, 6% had intracranial hemorrhage and 2% had developmental defects of brain.3% babies had history of trauma (table2).

Table2. Distribution of cases based on etiology

Etiology	Number	Percentage
Birth asphyxia	53	53
Infection	21	21
Hypoglycemia	10	10
Hypocalcemia	5	5
Birth trauma	3	3

Structural anomaly	2	2
Intracranial hemorrhage	6	6

Among the 100 neonates 40 neonates underwent mri.77.7 % term babies presented with seizures in 24 hrs of delivery.53.8% preterm babies presented with seizures within 24-72hrs of delivery. This was shown statistically significant difference between term and preterm babies in relation to time of onset of seizures ($p<0.05$) (table3). 50% babies with birth asphyxia had convulsions within 24hrs of birth, 17.5% with infection had seizures after 72hrsof birth.

Table3. Distribution of cases based on time of onset of convulsions

Time	Preterm		Term	
	No	%	No	%
<24hrs	4	30.7	21	77.7
24 – 72 hrs	7	53. 8	4	14.8
> 72hrs	2	15.3	2	7.4

42.5%babies had subtle convulsions, 40% babies had tonic convulsions, 12. 5% had mixed tonic and subtle and 5% had mixed subtle and clonic convulsions. None of the neonate had either clonic or myoclonic convulsions (table4).

Table4. Type of convulsions in neonates underwent MRI

Type	Number	Percentage
Subtle	17	42.5
Clonic	Nil	0
Tonic	16	40
Myoclonic	Nil	0
Subtle + clonic	2	5
Subtle + tonic	5	12.5

Among 40 neonates underwent MRI imaging 70 %(28) neonates had abnormal changes. All 32.5 %(13) preterm babies had abnormal brain mri.30 %(12) term babies had normal brain MRI, 37.5 %(15) term babies had abnormal MRI.Perinatal hypoxic changes were common finding in term neonates (32.5%).intracranial hemorrhage was common finding in preterm neonates (22.5%).5% preterm babies had perinatal hypoxic changes. In preterm babies 2.5%had infarction and 2.5% had structural anomalies (table5).

Table5. MRI Changes in neonatal seizures

MRI changes	Term		Preterm	
	No	%	No	%
Normal	12	30		
Hie	13	32.5	2	5
Intracranial hemorrhage	2	5	9	22.5
Infarction	-	-	1	2.5
Structure anomalies	-	-	1	2.5
Total	27	67.5	13	32.5

Table 6. MRI changes in perinatal hypoxia

MRI changes	Term		Preterm	
	N0	%	No	%
Normal	7	31.8	-	
Mild to moderate insult	-		-	
Moderate to severe insult	9	40.9	-	
Very severe insult	4	18.8	-	
Periventricular leucomalacia	-		2	9

Most common abnormality found was perinatal hypoxic injury, was seen in 53.5% .40% term babies had moderate to severe asphyxial changes, 18%term babies had very severe insult.9% preterm babies had periventricular leucomalacia (Table6).

Preterms with infection had infarction (22.2%) and hemorrhage (22.2%).term babies with infection had normal MRI. 55.5% preterm babies had intra ventricular hemorrhage which was common type of hemorrhage found in this study 15 % babies with abnormal MRI had subtle seizures, 37.5% babies with abnormal MRI had

tonic seizures. There was significant association was found ($p<0.05$) between tonic seizures and abnormal MRI changes (table7).

Table7. Type of seizures versus MRI changes

Type of convulsions	MRI changes			
	Normal		Abnormal	
	No	%	No	%
Subtle	11	27.5	6	15
Tonic	1	2.5	15	37.5
Subtle + clonic			2	5
Subtle + tonic			5	10

V. Discussion

Incidence of seizures in babies admitted in nicu of Gandhi hospital was 8.3% which is comparable with the finding of Erikson etal[6] and Seay and bray[7] who estimated that 2-20% neonates in intensive care units have evidence of seizure activity at some time.There was no statistical significance in the incidence of convulsions in males compared to females which is consistence with Mary jo Lanska et al showed that neither race nor sex were significantly associated with seizures[8].In our study birth asphyxia (53%) was the commonest cause of seizures followed by infection (21%) which is similar to other studies, done by CraigWS, Tekgul h and leven et al[9, 10, 11].In our study subtle seizures were seen in 42.5% babies and were the commonest type neonatal seizures followed by tonic seizures 40%. Which is comparable to SattarA et al mentioned that subtle seizures (41.2%) were the most frequently observed type of seizure, followed by tonic (32.9%) and clonic (20.6%) seizures[15]. Upadhyaya et al mention that subtle seizures comprise a 50% neonatal seizure which is comparable to our study[12].Taksande et al and Soni et al in their studies also showed subtle seizures as the commonest type of seizure occurring in 50% and 37.5% respectively[13, 14].

Convulsions are generally expected to occur within the first several days following birth. In our study 53.8% of preterm babies had convulsions between 24-72hrs of birth and in term babies with convulsions 77.7% cases occurred within 24hrs of birth. Our study is comparable to Mark'sScher et al, showed that 47% of preterm and 87% of term babies had convulsions during the first 48hrs of life and 53% of preterm and 30% term babies had seizures beyond 48hrs of life [16]. Sanjeev KumarDigra showed majority of the neonates (45.09%) had seizures during first 24hrs, followed by 25.49% & 20.6% during next 24hr-72hr and 72hr-7days respectively.

Sedation is usually unnecessary for neonatal MRI imaging. A newborn usually sleeps for the most of the day & usually falls sound sleep after regular breast feeding .therefore pharmacological sedation is usually not used for MRI imaging if the study is performed after a regular breast feeding and after a period of sleep deprivation of the newborn. In our study 5 neonates were given sedation with intravenous midazolam 0.1 mg/kg. A study was done by Richard l. Robertson et al[17] showedeight patients underwent MR imaging without sedation and in 11 patients, sedation was obtained using i.v midazolam hydrochloride 0.1 mg/kg, lorazepam 0.1 mg/kg, or chloral hydrate 50 mg/kg p.o. As provided by neonatal intensive care specialists.

Out of 40 babies 28 (70%) neonates had abnormal MRI brain. This was comparable toa Billetop et al [18] showed64% had abnormal MRI findings. 53.5% neonates had perinatal hypoxic changes as compared to HLeth et al showed 61% changes were attributable to hypoxic [19].

In our study in perinatal hypoxic MRI changes were described depending on Barkovich and Triulzi classification.31.5% neonates had normal MRI. 40% term babies had moderate to severe injury(thalamus,basalganglia),18% term babies had very severe injury(diffuse cortical abnormalities).9%preterm babies had periventricular leucomalacia. In another study was done by Steven p. Miller et al found watershed pattern of injury was seen in 78 newborns (45%), the basal ganglia/thalamus pattern was seen in 44newborns (25%), and normal MRI studies were seen in 51 newborns (30%). The basal ganglia/thalamus pattern was associated with more severe neonatal signs, including more intensive resuscitation at birth ($p = .001$), more severe encephalopathy ($p = .0001$), and more severe seizures ($p = .0001$). The basal ganglia/thalamus pattern was associated with the most impaired motor and cognitive outcome at 30 months. Christine p et al mentioned that the most common location for injury to the premature brain is the periventricular white matter, with ischemic parenchyma manifesting as PVL[22]. Baenziger, et al defined on the basis of MRI examination in 88 neonates and infants with perinatal asphyxia, 6 different patterns on t2-weighted images: pattern a- diffuse brain injury; pattern b-parasaggital hyper intensity; pattern c-hyper-and hypointense lesions in thalamus and basal ganglia; pattern d- periventricular leucomalacia (pvl), pattern e-small multifocal lesions pattern f-periventricular centrifugal hypo intense stripes in the centrum semiovale and deep white matter of the frontal and occipital lobes. Patterns a, b and c were found in 17%, 25% and 37% of patients, and patterns d, e and f in 19%, 17% and 35%, respectively[21].

In our study we found there is a significant relation between type of seizures and abnormal MRI findings i.e. 37.5% babies with abnormal MRI had tonic seizures and preterm babies with infection had high incidence of MRI changes in the form of infarction and hemorrhage.

VI. Conclusion

Perinatal asphyxia (53%) is the commonest cause of neonatal seizures. Subtle seizure (42.5%) is the commonest type of neonatal seizures. Most of the term babies (77.7%) will have seizures during first 24 hours of life and the preterm babies (53.8%) will have seizures during 24-48 hours of life.mri detected markedly high incidence of brain lesions in 70% neonates with neonatal seizures. Term babies had increased incidence of abnormal MRI findings (40%). The most common findings were related to hypoxic ischemic encephalopathy, which constitute 53.5% of cases. Perinatal hypoxic changes are commonly seen in thalamus and basal ganglia (40%). Neonates with tonic convulsion (37.5%) had increased incidence of abnormal MRI changes. Preterms with infection had infarction (22.2%) and hemorrhage (22.2%).Intraventricular hemorrhage is the commonest type of cerebral hemorrhage in preterm babies (55.5%). MRI should be done in every case of neonatal convulsion secondary to perinatal asphyxia and tonic seizures irrespective of gestational age and in all Preterms with neonatal sepsis in settings where facilities are available ,so that presence and extent of brain damage can be defined more clearly ,which helps in better prognostification of these cases

References

[1]. Miller sp, Weiss j, Barnwell a et al. Seizure-associated brain injury in term newborns with perinatal asphyxia. Neurology 2002; 58:542-8.
[2]. Volpe JJ (1989) neonatal seizures: current concepts and revised classification. Pediatrics84:422–428
[3]. Sarnat HB, Sarnat MS (1976) neonatal encephalopathy following fetal distress. Arch neurol33:696–705.
[4]. Barkovich Aj. Pediatric Neuroimaging. 3rd ed. Philadelphia: LippincottWilliams&Wilkins.
[5]. Triulzi f, Baldoli c, Parazzini c.Neonatal MR imaging. Clin n am 2001 feb; 9(1): 57-82.
[6]. Eriksson M, Zetterstorm. Neonatal convulsions. Acta pedict scand 1979; 68: 807-11.
[7]. Seay AR, Bray PF. Significance of seizures in infants less than 2500gms. Arch neurol 1977; 34: 381.
[8]. Mary JoLanska, et al. Neonatal seizures .Neuroepidemiology 1996; 15:117–125.
[9]. Craig WS. Convulsive movements occurring in the first 10 days of life. Arch dis child 1960; 35: 336-44.
[10]. Levene ml, Trounce Jq. Neonatal seizures towards more precise diagnosis. Arch dis child 1968; 61: 78-87.
[11]. Tekgul H, Gauvreau K, Soul J et al. The current etiologic profile and neurodevelopmental outcome of neonatal seizures in the current era of neonatal intensive care and to identify predictors of neurodevelopmental outcome in survivors. Pediatrics 2006; 117: 1270-1280.
[12]. Upadhyay A, Aggarwal R, Devrari AK, Bhutain VR. Protocols in neonatology. Indian j pediatr: ambassador, New Delhi 2005:61-71.
[13]. Taksande A, VilhekarK.Clinicobiochemical profile of neonatal seizures. Indian j of pediatr 2005; 52:424-7.
[14]. Soni a, SabarawalAK, Amita k. Clinical profile of seizures in neonatal intensive care unit. In: manual abstract of xx111 annual convention of national neonatology forum. 2003; 43: 109-110.
[15]. Sattar SA, Hameed N. Incidence and etiology of neonatal seizures. Pak pediatr j 2006; 30(4] 168-73.
[16]. Mark S. Scher et al.Electrographic seizures in preterm and full-term neonates: clinical correlates, associated brain lesions, and risk for neurologic sequelae. Official journal of the American academy of pediatrics January 1993, volume 91 / issue1.
[17]. Richard l. Robertson et al. MR line-scan diffusion-weighted imaging of term neonates with perinatal brain ischemia. Ajnr am j Neuroradiol20:1658–1670.
[18]. A Billetop, EOsmond, J. Neonatal seizures: The utility of magnetic resonance imaging in diagnosis and prediction of neurodisability. Arch dis child 2013; 98:a79 doi:10.1136/archdischild-2013-304107.184.
[19]. H leth, P B Toft, M Herning, BPeitersen, HCLou: neonatal seizures associated with cerebral lesions shown by magnetic resonance imaging. Arch dis child 1997; 77:f105–f110.
[20]. Steven P. Miller et al: patterns of brain injury in term neonatal encephalopathy: j pediatr 2005; 146:453-60.
[21]. Baenziger O, Martin e, Steinlin M, Largo R, Burger R, et al. Early pattern recognition in severe perinatal asphyxia: a prospective MRI study. Neuroradiology 1993; 35:437-42.
[22]. Christine p. Chao, Christopher G.Neonatal hypoxic-ischemic encephalopathy: multimodality imaging findings. Radio graphicsOctober 2006volume 26, issue suppl_1.