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ELECTROENCEPHALOGRAPHIC AND CRANIAL USG STUDIES IN FULL TERM NEWBORN WITH BIRTH ASPHYXIA AND THEIR RELATION WITH IMMEDIATE OUTCOME

Paediatrics

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ABSTRACT

Background: Neonatal asphyxia is single most important cause of neurological morbidity and mortality in the first week of life in the full-term infants. It occurs in 0.5% of full term newborns. Amongst which incidence of early death was 7% and neurological handicap was 28%. The exact prognosis of infants who survive severe asphyxia is difficult to judge. A combination of abnormal neurological signs with investigations including cranial USG, CT, EEG studies for determining neurological damage is more helpful in predicting the outcome.

Aims: To study the EEG patterns and cranial USG in asphyxiated full term new born babies within first seven days. To determine the prognostic importance for immediate outcome of SARNAT and SARNAT scores, EEG and Cranial USG, abnormalities seen during the first seven days in full term newborns with birth asphyxia.

Methodology: Prospective study conducted in Apple Saraswati Multispeciality Hospital from Dec. 2016 to Nov. 2018. Study includes 55 neonates admitted during this period; out of which 40 were cases and 15 were controls. They were categorised according to SARNAT and SARNAT scoring as HIE grade I, II and III. In all neonates, EEG was recorded within 7 days and cranial USG was done on 4th day of life. Repeat neurological examination was done on 7th day of life, and correlated with SARNAT and SARNAT score, cranial USG and EEG. Statistical analysis in relation to asphyxiated status, immediate outcome and EEG record was done using chi-square evaluation with 'P' value of less than 0.05 considered as significant.

Result: In our study, out of 40 cases, it was observed that, according SARNAT and SARNAT scores, 7 babies were with HIE grade I, 28 with HIE grade II and 5 with HIE grade III. Amongst which survival rate was 100%, 78% and 0% respectively at the end of 7th day. Out of 22 babies of HIE grade II, 10 babies (46%) have abnormal neurological examination and out of HIE grade I all are normal. Abnormal EEG pattern was seen in 3 babies (43%) with HIE grade I, 25 babies (89%) with HIE grade II all 5 babies (100%) with HIE grade III. Out of 33 babies with abnormal EEG, 11 expired (33%) at 7th day of life. Therefore, EEG is good predictor of immediate outcome. Cranial USG finding revealed, 12 babies (92%) with grade II ICH amongst which survival rate was 58%, and 1 baby (8%) with grade III ICH with 0% survival. Out of 13 babies with abnormal USG, only 7 (54%) survived till 7th DOL and of which 4 (57%) were found with abnormal neurological examinations on 7th day of life. Out of 27 babies with normal cranial USG only 22 (81%) survived till 7th DOL, of which 6 (27%) babies show some neurological abnormality at 7th day of life.

Conclusion: EEG and cranial USG, appears to be non-invasive diagnostic and prognostic tools in investigations of babies with birth asphyxia. Normal EEG patterns, normal cranial USG findings with normal neurological examinations on 7th day life was 100% associated with good immediate outcome. Abnormal EEG patterns showed neurological deficits in 45% of babies, and mortality is 33% babies in immediate neonatal period. The severity of ICH is also directly proportional to mortality and morbidity. EEG, cranial USG and SARNAT and SARNAT scoring taken together gives most accurate prediction on neurological development of babies with birth asphyxia and its immediate outcome.

KEYWORDS

EEG, Cranial USG, Full term, Birth Asphyxia, SARNAT and SARNAT scoring, Immediate Outcome.

INTRODUCTION

Birth Asphyxia is an insult to the foetus or newborn due to lack of oxygen or lack of perfusion to various organs, leading to acidosis, hypoxemia and hypercapnia 1. Neonatal Asphyxia is the single most important cause of neurological morbidity and mortality in the first week of life in the term infant 2. Overall incidence of neonatal asphyxia is about 0.5 % of full term live borns 1. Among full-term neonates with a history of an asphyxia episode and an abnormal neurological examination during first 7 days of life, the incidence of early death was 7% and incidence of neurological handicap was 28% 3. Term newborn with mild asphyxia probably recover completely [4].

Asphyxia in term newborn leads to hypoxic/ischemic encephalopathy (HIE) 5,6. HIE can be graded clinically by methods like SARNAT and SARNAT score 5. The exact prognosis of infants who survive severe asphyxia is difficult to judge from isolated case reports of successful outcome and also by retrospective studies of children with cerebral palsy.

During the critical neonatal period, it is mainly the anatomy and physiology of the perinatal brain which determines the neurological injury and subsequent outcome. It is well known fact that 90% of brain growth occurs in the first two years of life and any perinatal insult leads to significant mortality and morbidity either in the immediate or late post natal life. It has been rightly said by Margaret Norman that "No other organ changes as much as the brain does form 24th week of gestation to 1 year of age, "Birth" is the only 'an incident' which occurs while the brain is growing and developing" [7].

Opinions differ greatly with regards to the reliability of the neurological examination in predicting neurological and intellectual outcome in newborn. A combination of abnormal neurological signs with investigations determining neurological damage is more helpful than a single sign/investigation in predicting the outcome.

In an attempt to determine the extent of perinatal central nervous injury and predict immediate and long-term outcome, various investigations including cranial ultrasonography (USG), Computerized Tomography (CT), Electroencephalography (EEG), Positron Emission Tomography (PET) and Magnetic resonance Imaging (MRI) are currently being used at advance centres. They provide specific neurological diagnosis which is crucial to the immediate and long-term management of neonates at risk.

Electroencephalography (EEG) is the study of recording of electrical activity of the brain. It has been found that, even a single EEG done early in the course of asphyxia neonatorum is a more sensitive predictor of immediate outcome 8,9. EEG is non-invasive and relatively cheaper. It was found that EEG and neurological evaluation done by SARNAT and SARNAT score can provide best possible

correlation with immediate outcome of the asphyxiated full term newborn [10,11].

The incidence of intracranial haemorrhage (ICH) increases with decreasing birth weight. Overall incidence of ICH in full term newborns is 1/100 live births 12. Although ICH is predominantly a lesion of premature infants, this variety of haemorrhage has been documented repeatedly by CT and Cranial USG, as well as by post mortem study of term infants 13, 14. In term infants, the large majority of ICH emanate from bleeding in choroid plexus particularly the posterior tufts at the glomus [13,15].

Cranial Ultrasonography (USG) is recording the reflection of ultrasonic waves (sound waves having frequency >20,000 CPS) directed into the brain tissue. Anterior fontanelle acts as a window to the neonatal brain. It is a non-invasive technique and does not cause threat of radiation hazards. Hence repeated scans can be done to follow the evolution of the haemorrhage. However, it has got its own limitations. When size of the fontanelle is small, visualization of all the intracranial structures may become difficult. Cranial USG is also inadequate for visualization of cerebral edema, surface lesions and lesions at the base of brain. However, it is an excellent tool for determination of ventricular size. It is cheaper investigation and done quickly with causing less hazards to the neonates.

In the present study, different wave patterns by EEG and presence or absence of ICH by cranial USG has been given main stress. An attempt was made to correlate the SARNAT and SARNAT score, cranial USG, Electroencephalography and outcome of full term newborns with birth asphyxia, within first 7 days of post-natal life. More long-term studies will be required for knowing future neurological status.

AIMS AND OBJECTIVE

1. To study EEG patterns and cranial USG findings in normal full term newborn babies in the first 7 days of post-natal life.

2. To study EEG patterns in asphyxiated full term newborn babies in the first 7 days of post-natal life.

3. To study cranial USG findings in asphyxiated full term newborn babies around 4th days of post-natal life.

4. To determine prognostic importance for immediate outcome of the SARNAT AND SARNAT score, EEG and cranial USG, abnormalities seen during first 7 days of life in full term newborn babies with birth asphyxia.

MATERIAL AND METHODS

Prospective study conducted in Apple Saraswati Multispeciality Hospital, Kolhapur, Maharashtra from Dec. 2016 to Nov. 2018 over period of 2 years.

The study was done in around 55 neonates who were admitted within this period, out of this 15 were control (full term baby) and 40 were cases with birth asphyxia, in these babies EEG and cranial USG were done between 3rd and 7th DOL. Detail obstetric history of 55 neonates included in study and CBC, Sr. Calcium, Sr. Electrolyte and BSL done within an hour. Neurological examination was performed within one hour of admission, then daily till 7th DOL.

The neonates were scored as per SARNAT and SARNAT score and clinical staging of HIE was done. In this study, single EEG recording was done within 7 days of post-natal life in all 55 neonates, mostly during sleep. EEG recording were examined and reported by neurologist and psychiatrist, both were aware of clinical status of infant.

EEG patterns were classified as: 16
1. Background activity symmetry
2. Low voltage
3. Bust suppression pattern
4. Neuronal Hyperexcitability
5. Cortical dysfunction
6. Seizure activity
7. Borderline abnormality

Cranial USG was done within 4th day of post natal life. In those who diagnosed to have ICH, repeat scan was done on 7th DOL to look for maximal extent of haemorrhage and dilation of ventricles.
USG finding were described as presence or absence of following: 17, 18
1. Subependymal echo density
2. Ventricular internal echoes
3. Dilation of ventricles
4. Periventricular echoes
5. Intraparenchymal echo density
6. Thalamocaudate echo density
7. Midline shift to right or left
8. Congenital malformations

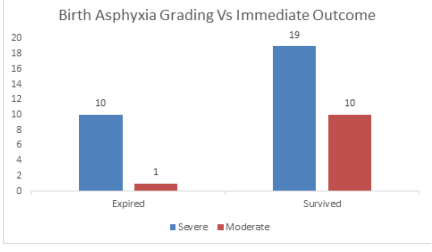
ICH Grade As: [17,18]
1. Subependymal haemorrhage
2. ICH without ventricular dilation
3. ICH with ventricular dilation
4. Extension in to parenchymal
Detailed neurological examination done on 7th DOL in those neonates who survived of asphyxia. Finally, all attempts were made to correlate the SARNAT and SARNAT score, cranial USG and EEG and outcome of asphyxiated full term babies within first 7 DOL. Statistical Analysis in relation to asphyxia staging, its immediate outcome and EEG record and Cranial USG finding was done using the chi- square evaluation with P value less than 0.5 considered as significant.

Result:

1. Out of 40 babies with birth asphyxia, 29 babies (72%) have severe asphyxia, out of which only 19 (66%) were survived till 7th DOL and 11 babies (28%) have moderate asphyxia, out of which 10 (91%) were survived till 7th DOL.

Table 1: SEVERITY OF BIRTH ASPHYXIA BY APGAR VS IMMEDIATE OUTCOME

Birth Asphyxia Grading (n=40)	Total No	Expired	Survived
Severe (Apgar 1min <=3)	29 (72%)	10 (34%)	19 (66%)
Moderate (Apgar 5min <=6)	11 (28%)	1 (9%)	10 (91%)
Total	40 (100%)	11 (27%)	29 (73%)

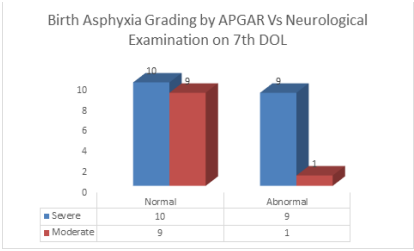


Graph 1: SEVERITY OF BIRTH ASPHYXIA BY APGAR VS IMMEDIATE OUTCOME

2. Out of 19 severe asphyxiated newborns who survived till 7th DOL, 10 babies (53%) were having normal neurological examination at 7th DOL, 9 (47%) were having abnormal examination. Out of 10 with moderate asphyxia who survived till 7th DOL, 9 (90%) were having normal neurological examination and only 1 (10%) baby have abnormal examination.

Table 2: SEVERITY OF BIRTH ASPHYXIA BY APGAR VS NEUROLOGICAL EXAMINATION IN SURVIVOURS BY 7th DOL

Birth Asphyxia Grading (n=29)	Total No. of Survivors	Neurological Examination on 7th DOL	
		Normal	Abnormal
Severe (Apgar 1min <=3)	19 (66%)	10 (53%)	9 (47%)
Moderate (Apgar 5min <=6)	10 (34%)	9 (90%)	1 (10%)
Total	29 (100%)	19 (66%)	10 (34%)



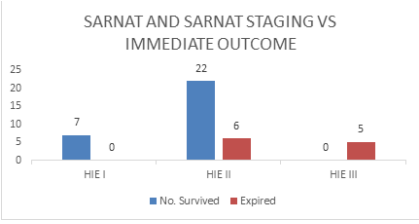
Graph 2: SEVERITY OF BIRTH ASPHYXIA BY APGAR VS NEUROLOGICAL EXAMINATION IN SURVIVOURS BY 7th DOL

3. According to SARNAT and SARNAT staging, out of 40, 7 having grade I HIE (18%) all are survived (100%), 28 having grade II HIE (70%) out of this 22 survived (79%), 5 having grade III HIE (12%), no one is survived.

Table 3: SARNAT AND SARNAT STAGING VS IMMEDIATE OUTCOME

HIE Grading (N=40)	Total No.	No. Survived	Expired
HIE I	7 (18%)	7 (100%)	0 (0%)
HIE II	28 (70%)	22 (79%)	6 (21%)
HIE III	5 (12%)	0 (0%)	5 (100%)
Total	40 (100%)	29 (73%)	11 (27%)

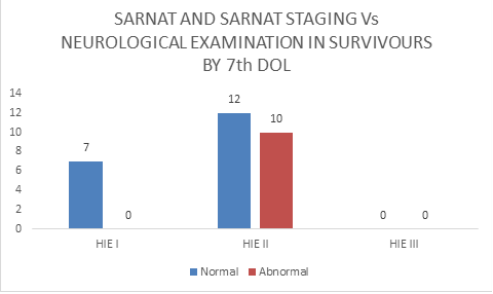
Test of Significance: Between I and II – P < 0.5 Not significant
Between II & III – P < 0.001 Significant
Between I & III – P < 0.001 Significant



4. Neurological examination was done on 7th DOL in HIE survivors, all HIE grade I babies having normal neurological examination i.e 7 (100%), 10 (46%) of 22 with HIE grade II having abnormal neurological examination.

Table 4: SARNAT AND SARNAT STAGING Vs NEUROLOGICAL EXAMINATION IN SURVIVOURS BY 7th DOL

HIE Grading (n=29)	Total No. of Survivors	Neurological Examination on 7th DOL	
		Normal	Abnormal
HIE I	7 (24%)	7 (100%)	-
HIE II	22 (76%)	12 (54%)	10 (46%)
HIE III	0 (0%)	-	-
Total	29 (100%)	19 (66%)	10 (34%)

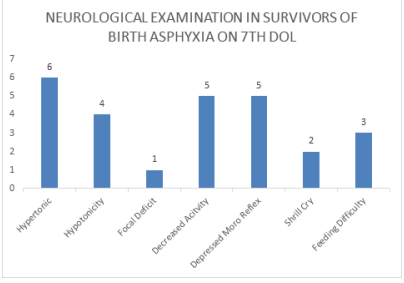


Graph 4: SARNAT AND SARNAT STAGING Vs NEUROLOGICAL EXAMINATION IN SURVIVOURS BY 7th DOL

5. In the Neurological examination of 29 newborn who survived at the end of 7th DOL, 19 (66%) had normal neurological examination findings. And Out of 10 (34%) who had abnormal findings, 6 (60%) had hypertonicity, hypotonicity was found in 4 (40%), Focal deficit was present in 1 (10%), Decreased activity in 5 (50%), Depressed Moro reflex in 5 (50%), Shrill cry in 2 (20%) and feeding difficulty in 3 (30%).

Table 5: NEUROLOGICAL EXAMINATION IN SURVIVORS OF BIRTH ASPHYXIA ON 7TH DOL

Examination Findings	Total No. Babies	Percentage
Normal	19	66%
Abnormal	10	34%
In Abnormal Findings: (n=10)		
A) Tone abnormality		
1. Hypertonic	6	60%
2. Hypotonic	4	40%
B) Focal Deficit	1	10%
C) Decreased activity	5	50%
D) Depressed Moro Reflex	5	50%
E) Shrill Cry	2	20%
F) Feeding Difficulty	3	30%

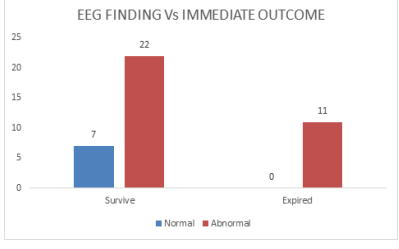


Graph 5: NEUROLOGICAL EXAMINATION IN SURVIVORS OF BIRTH ASPHYXIA ON 7TH DOL

6. Out of 40 babies with birth asphyxia whose EEG was done, 7 babies (18%) have normal EEG and all survived till 7th DOL and 33 babies (82%) have abnormal EEG pattern, only 22 (67%) were survived till 7th DOL.

Table 6: EEG FINDING Vs IMMEDIATE OUTCOME

EEG Pattern (N=40)	Total No.	Outcome	
		No. Survived	Expired
Normal	7 (18%)	7 (100%)	0 (0%)
Abnormal	33 (82%)	22 (67%)	11 (33%)
Total	40 (100%)	29 (73%)	11 (27%)



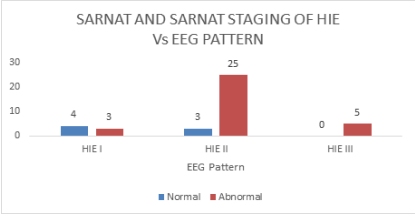
Graph 6: EEG FINDING Vs IMMEDIATE OUTCOME

7. Of 40 babies with HIE according to Sarnat and Sarnat Grading EEG studies were done. It showed EEG pattern study in HIE grade I babies only 3 (43%) having abnormal EEG pattern, in HIE grade II babies 25 (89%) having abnormal EEG pattern and 100% in HIE grade III have abnormal EEG pattern.

Table 7: SARNAT AND SARNAT STAGING OF HIE Vs EEG PATTERN

HIE Grading (n=40)	Total No.	EEG Pattern	
		Normal	Abnormal

HIE I	7 (18%)	4 (57%)	3 (43%)
HIE II	28 (70%)	3 (11%)	25 (89%)
HIE III	5 (12%)	0 (0%)	5 (100%)
Total	40 (100%)	7 (18%)	33 (82%)

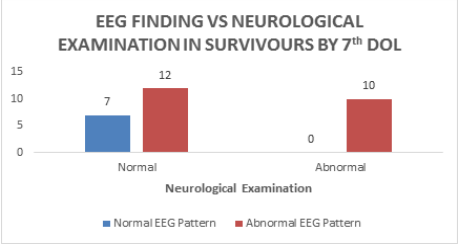


Graph 7: SARNAT AND SARNAT STAGING OF HIE Vs EEG PATTERN

8. Out of 29 newborns on 7th DOL, 7 (24%) had normal EEG pattern and all were having normal neurological examination on 7th DOL, Out of 22 (76%) who have abnormal EEG pattern 12 (55%) had normal neurological examination and only 10 (45%) baby have abnormal neurological examination on 7th DOL.

Table 8: EEG FINDING VS NEUROLOGICAL EXAMINATION IN SURVIVOURS BY 7th DOL

EEG Pattern (n=40)	Total No. of Survivors	Neurological Examination on 7th DOL	
		Normal	Abnormal
Normal (n=7)	7 (24%)	7 (100%)	0 (0%)
Abnormal (n=33)	22 (76%)	12 (55%)	10 (45%)
Total	29 (100%)	19 (66%)	10 (34%)

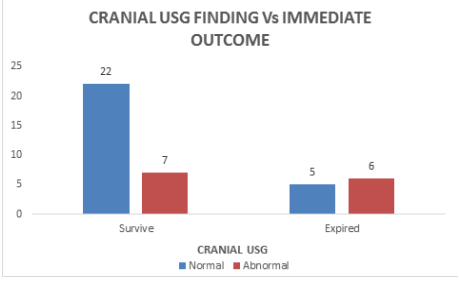


Graph 8: EEG FINDING VS NEUROLOGICAL EXAMINATION IN SURVIVOURS BY 7th DOL

9. Out of 40 babies with birth asphyxia whose Cranial USG was done, 27 babies (68%) have normal cranial USG finding, out of which only 22 (81%) were survived till 7th DOL and 13 babies (32%) have abnormal Cranial USG findings, out of which 7 (54%) were survived till 7th DOL.

Table 9: CRANIAL USG FINDING Vs IMMEDIATE OUTCOME

Cranial USG (N=40)	Total No.	Outcome	
		No. Survived	Expired
Normal	27 (68%)	22 (81%)	5 (19%)
Abnormal	13 (32%)	7 (54%)	6 (46%)
Total	40 (100%)	29 (73%)	11 (27%)

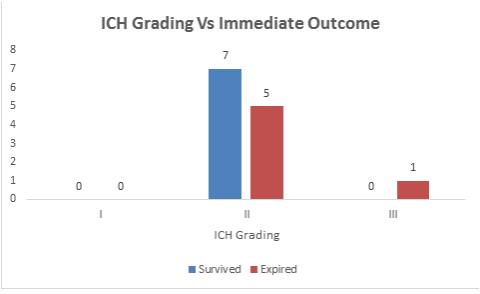


Graph 9: CRANIAL USG FINDING Vs IMMEDIATE OUTCOME

10. ICH Grading was done in 13 newborns who had abnormal findings on Cranial USG, of which none had grade I ICH, 12 (92%) had grade II ICH of which 7 (58%) survived till 7th DOL and 5 (42%) expired, 1 (8%) had grade III ICH and could not survive till 7th DOL.

Table 10: Distribution of Babies as Per ICH Grading Vs Immediate Outcome

Grades of ICH (n=13)	Total No.	Outcome	
		Survived	Expired
I	0 (0%)	-	-
II	12 (92%)	7 (58%)	5 (42%)
III	1 (8%)	0 (0%)	1 (100%)
Total	13 (100%)	7 (54%)	6 (46%)

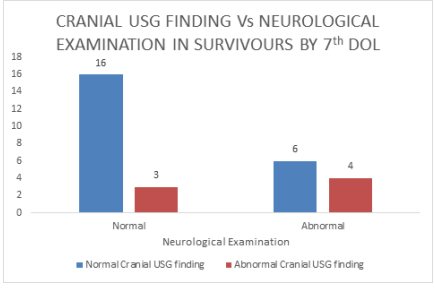


Graph 10: Distribution of Babies as Per ICH Grading Vs Immediate Outcome

11. Out of 29 newborns who survived till 7th DOL, 22 (76%) had normal Cranial USG of which 16 (73%) were having normal neurological examination and 6 (27%) had abnormal neurological examination on 7th DOL , Out of 7 (24%) who have abnormal Cranial USG, only 3 (43%) had normal neurological examination and 4 (57%) had abnormal neurological examination on 7th DOL.

Table 11: CRANIAL USG FINDING Vs NEUROLOGICAL EXAMINATION IN SURVIVOURS BY 7th DOL

Cranial USG (n=40)	Total No. of Survivors	Neurological Examination on 7th DOL	
		Normal	Abnormal
Normal (n=27)	22 (76%)	16 (73%)	6 (27%)
Abnormal (n=13)	7 (24%)	3 (43%)	4 (57%)
Total	29 (100%)	19 (66%)	10 (34%)



Graph 11: CRANIAL USG FINDING Vs NEUROLOGICAL EXAMINATION IN SURVIVOURS BY 7th DOL

Conclusion :

EEG and cranial USG, appears to be non-invasive diagnostic and prognostic tools in investigations of babies with birth asphyxia. The use of SARNAT and SARNAT for evaluation of asphyxiated babies, even without EEG recording allows for reasonable accuracy prognosis regarding immediate outcome. Normal EEG patterns in babies with normal neurological examinations on 7th day life and normal cranial USG findings was 100% associated with good immediate outcome. Abnormal EEG patterns is associated with neurological deficits in 45% of babies and mortality is in 33% babies in immediate neonatal period. The EEG pattern associated with high mortality and morbidity

are flat tracings, low voltage and burst suppression pattern. The severity of ICH is directly proportional to mortality and morbidity. A normal cranial USG finding, does not guaranty a normal neuro development, but suggest a good probability of normal development particularly it associated with normal EEG and uneventful clinical course. EEG, cranial USG correlated well with each other and with SARNAT and SARNAT scores. These three investigations taken together gives very useful information on brain function, severity of brain injury and are most accurate on predicting neurological development of babies with birth asphyxia and its immediate outcome.

REFERENCES :

1. Clohert J.P., Stark A.R.: Perinatal Asphyxia: Manual of neonatal care: 2nd edi.:1985;315-321.
2. Vople JJ : Perinatal hypoxic ischaemic brain damage: Ped. Clin. N. America:1976; 23:383-397.
3. Brann A.W. Jr. : HIE (Asphyxia): PCNA: 1986 June; 33: 31: 451-463.
4. Brann A.W. : HIE: PCNA:1986;33:3.
5. Sarnat & Sarnat : Neonatal Encephalopathy following fetal distress: Arch. Neurology: 1976;33:696-705.
6. Volpe JJ : Textbook of neurology of newborn: WB Saunders: 1981; Vol. 22.
7. Ambrose James : Computerized transverse axial scanning II : Br. J. Radio. 1973;46:1023.
8. Burke J. : Prognostic significance of neonatal seizures : Arch. Diseases Child: 1954.
9. Monod et al: The neonatal EEG: Statistical Studies and prognostic value in fullterm and preterm babies: Electroencephalograph. Clinical Neurophysiol. : 1972;32:529-544.
10. Merchant et al. : CT and EEG in immediate evaluation of term infants with a symp. Birth asphyx. : IJP. 1984;51:327-332.
11. Minkowaski et al : Outcome of neonatal seizures : Arch. French Ped. :1955;12:371.
12. Fedrcih et al : Causes of neonatal death: IVH: Biol. Neonate: 15:257-290.
13. Donat J.F. et al : IVH in full term and preterm infants: Mayo Clinic Proceeding. July 1978;Vol 53:437-441.
14. Dubowitz L.M.S. et al : Neurological signs in neonatal IVH: Jr. Ped. 1981;99:127.
15. Palma et al: IVH in neonates : Am. J.D.C. : 1979;133:941.
16. Merchant et al : EEG in evaluation of term asphyxiated neonates. : Indian Ped. Aug 1985; 22: 585-595.
17. Burstein J. Papile L et al : IVH & Hydrocephalus in premature newborns: Roentgenol:1979;1332:631-635.
18. Papile L.A. et al : Incidence and evaluation of subependymal and IVH: Jr.Ped.:1978;92:529-534.