

Original Research Article

## Assessment of Intraventricular Haemorrhage in Preterm Neonates Using Neurosonography through Anterior Fontanelle

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### ABSTRACT

**Background:** Cerebral intraventricular haemorrhage (IVH) is the most common CNS lesion found in autopsy of newborn. It occurs almost exclusively in premature infants less than 2500 gm. About 90 % of IVH originate in subependymal germinal matrix.

Modern and advanced neonatal care has reduced the mortality rate of preterm and extreme preterm neonates but if the incidence of IVH is not decreased, then the morbidity will increase in future and it will be a great psychological trauma to parents and society.

It is important to regularly monitor IVH with neurosonography at regular intervals to prevent advancement of grade I hemorrhage to higher grades. Because grade III and IV hemorrhage has much worse prognosis than grade I hemorrhage. Also mortality is much higher with higher grades of hemorrhage.

**Aim:** To assess the distribution of IVH and its risk factors using Neurosonography.

**Material & Methods:** Present prospective study was conducted in preterm newborns admitted in Nicu having intraventricular haemorrhage (IVH). Study was conducted over period of 2 years. Study group comprised of 545 preterm neonates admitted who fulfilled inclusion criteria of study. Radiological assessment was done with serial USG through anterior fontanelle (Neurosonography). Babies with clinical suspicion of IVH but normal Neurosonogram were subjected to C.T. Scan brain.

**Result:** IVH was found in 10.8% (59 babies). Highest incidence (52.5%) was found between gestational age of 26 – 30 weeks. Majority of IVH babies i.e 38 (68.6%) had birth weight less than 1kg. Incidence of IVH in babies of mother who had not received antenatal steroids was 77.96%. USg through anterior fontanelle could detect IVH in 100% of babies with IVH. Mortality rate was highest in grade 4 IVH & lowest in grade I IVH.

**Conclusion:** IVH is more common in extreme preterm and ELBW babies. Antenatal steroids is found to be beneficial in decreasing incidence of IVH in preterm babies in this study. Mortality rate increases as grades of IVH increases. Neurosonography is very effective to detect even early grades of IVH.

**Key words:** preterm, low birth weight, intraventricular hemorrhage, neurosonogram

### INTRODUCTION

Intraventricular hemorrhage (IVH) is defined as intracranial bleeding in the ventricles. Approximately 30% of

premature infants less than 1500 grams will have IVH. Cerebral IVH is the most common CNS lesion found in autopsy of newborn. About 90% of IVH originate in

the subependymal germinal matrix. <sup>[1]</sup> In approximately half of cases, IVH occurs within first 6-8 hours & represent a major cause of handicap in preterm neonates. <sup>[2]</sup> The site of origin of IVH in premature infants is germinal matrix, a subependymal region found at the external angle of both lateral ventricles. The endothelial layers of these vessels histologically have minimal collagen basement membrane or muscle cells support. It is from these vessels that bleeding is believed to occur. <sup>[3]</sup> The larger diameter of these vessels may permit greater pressure to be exerted on their walls and thus make them more susceptible to hemorrhagic disruption. <sup>[4]</sup> There are various factors mentioned to as risk factors for IVH choice will be verified in this study. <sup>[5]</sup> Post hemorrhagic Ventricular Dilation (PVD) or Post hemorrhagic hydrocephalus (PHH) may occur days to weeks following onset of IVH. The pathogenesis of which is partly related to impaired CSF resorption & /or obstruction of aqueduct or foramina of luschka or magendie by particulate clot. <sup>[3]</sup> The diagnosis of IVH may be suspected on clinical basis only in only 50% of patients. Clinical features may be absent, subtle or life threatening. <sup>[6]</sup> Futagi y et al (2006) stated that in infants with grade I or II bleeding have outcomes similar to premature babies who do not have IVH. <sup>[7]</sup> More severe grades of hemorrhages are associated with a higher incidence of neuron developmental handicap. <sup>[8,9]</sup> Volpe JJ (1989) also showed that mortality is higher in those infants with IVH when compared with their gestational age matched peers without hemorrhage. <sup>[10]</sup>

Although modern and advanced neonatal care has reduced the mortality rate of preterm and extreme preterm neonates. If incidence of intraventricular hemorrhage is not decreased than the morbidity will increase in future and will be a great psychological trauma to parents and also to the society so this study was conducted to find out important risk factors associated with IVH and to evaluate utility of neurosonogram in diagnosis of IVH.

## MATERIALS AND METHODS

This prospective study was conducted in Neonatal intensive care unit from August 2007 to August 2009 after taking clearance from Hospital ethical committee. The informed written consent from parents was taken. Natal history is taken to determine type of delivery any associated factors like premature rupture of membranes, antenatal steroids given or not, tracheal suctioning, resuscitation, Apgar score etc. Total 545 preterm babies admitted in NICU were included in study. All preterm babies admitted and treated in NICU and in whom necessary investigations could be done including neuroimaging were included in study.

Preterm babies in whom radioimaging could not be done are excluded from the study. Detailed clinical examination for signs and symptoms suggestive of IVH (like convulsions, apathy, lethargy, hypotonia, bradycardia, bulging of anterior fontanelle) is done.

**Preterm Babies:** Babies born before the 37 weeks of gestational age (GA is based on Lmp/USG/new Ballard score)

IVH on USG through anterior fontanelle is diagnosed in presence of hyperechogenicity in ventricle of brain.

**IVH on CT Scan:** Is diagnosed in presence of hyper density in ventricle of brain.

The diagnosis of IVH is almost invariably made by real time portable cranial ultrasonography (CUS), in premature infant.

Radiological assessment is undertaken with serial USG through Anterior fontanelle (Af). In babies in whom IVH is detected grading of IVH is done with CT Scan and USG through Af. In any baby with IVH, serial USG through Af is done to monitor for grades of IVH. Babies with clinical suspicion of IVH but normal USG through Af were also subjected to CT Scan and findings noted.

**Grading of germinal matrix haemorrhage / intraventricular haemorrhage (GMH / IVH)**

**Papile (by CT scan)**

Grade 1- Isolated GMH (no IVH)

Grade 2- IVH without ventricular dilation  
 Grade 3- IVH with ventricular dilation  
 Grade 4- IVH with parenchymal haemorrhage

**Volpe (by Cranial USG)**

Grade 1- GMH with no or minimal IVH (<10% ventricular volume)

Grade 2- IVH occupying 10% - 50% of ventricular area on parasagittal view.

Grade 3- IVH occupying >50% of ventricular area on parasagittal view, usually distends lateral ventricle (at time of IVH diagnosis)

**RESULTS**

Out of total 545 cases studied, 59(10.8%) had IVH. (Table 1) This difference in the distribution of cases was statistically found to be significant ( $\chi^2 = 334.5, p < 0.05$ ).

The distribution of babies according to gestations age and presence or absence of IVH was statistically highly significant ( $\chi^2 = 147.32, p < 0.05$ ) of the total 59 babies with IVH majority i.e. 31 (52.5%) was between 26-30. (Table 2)

**Table 1: showing Distribution of IVH in Cranial Ultrasound and C.T. Scan Grading of IVH**

Neuroimaging	Number	Percentage
Normal	486	
IVH	59	10.82
Grade I	29	49.15
Grade II	13	22.03
Grade III	10	16.94
Grade IV	7	11.86

Although apparently higher proportion of male babies i.e. 35 out of 59 (59.3%) had IVH Compared to female babies this difference was not significant ( $\chi^2 = 0.0004, p < 0.05$ )

Majority of IVH babies i.e. 38 (66.6%) had birth Weight less than 1Kg. AS birth Weight increased the proportion of babies with IVH also decreased. (Table 3)

This difference in the distribution of babies according to birth Weight and presence / absence of IVH was statistically highly significant ( $\chi^2 = 205.8, p < 0.05$ )

Steroids taken by mother during antenatal period has been beneficial effect as out of 59 babies with IVH, majority i.e. 46 (78%) were such that their mothers had not received steroids during antenatal period. this difference was statistically significant ( $\chi^2 = 9.87, p < 0.05$ ). (Table 4)

**Table 2: Distribution of babies according to gestations age and presence or absence of IVH**

Gestational Age ( in weeks)	No. of babies		Total	Percentage of babies	
	With IVH	Without IVH		With IVH	Without IVH
26 – 30	31	20	51	52.34	4.11
30 – 34	19	127	146	32.20	26.13
34 – 36	9	339	348	15.25	69.76
Total	59	486	545		

**Table 3: Distribution of IVH according to Birth Weight**

Birth Weight (in Kgs)	No. of babies		Total	Percentage of babies	
	With IVH	Without IVH		With IVH	Without IVH
< 1Kg	38	19	57	64.40	3.09
1-1.5 Kg	14	265	279	23.72	54.52
> 1.5 Kg	7	202	209	11.86	41.56
	59	486	545		

**Table 4: Frequency Distribution by Antenatal Steroids**

Ante Natal Steroids	No. of Babies		Total	Percentage of Babies	
	With IVH	Without IVH		With IVH	Without IVH
Yes	13	326	339	22.03	67.07
No	46	160	206	77.96	32.93
Total	59	486	545		
$\chi^2 = 45.4, df=1, p<0.05$					

Amongst babies with IVH frequency distribution by postnatal events were as follows:

Also it was found that in 50 babies out of 59, seizures were absent and this difference

according to presence or absence of seizures was statistically significant ( $\chi^2 = 4.4, p < 0.05$ )

Out of 59 babies with IVH, 29 had grade I, 13 had grade II, 10 had grade 3, and 7 had grade IV IVH. (Table 5)

In our study about 86% of mortality is seen with grade 4 IVH. Also mortality increases steadily with increasing grades of IVH. (Table 6)

**Table 5: Risk factors associated IVH**

1	Post natal event	Percentage
2	Pneumothorax	2.3 %
3	Events of desaturation	25.2 %
4	Fluctuations in BP	17.3 %
5	Ventilatory care	6.7 %
6	Rapid boluses	18.9 %
7	Tracheal suctioning	3.3 %
8	Hyponatremia	8.2 %
9	Exchange Transfusion	17.1 %
10	Blood gas disturbances	9.1 %
11	Inotropes	5.8 %
12	Hypoglycemia	21.1 %
13	endotracheal Intubation	8.3 %
14	Delayed cry	29.1 %

**Table 6: Mortality rate with Grades of IVH**

Grades of IVH	Number	Percentage of Mortality
1	6	20.68 %
2	5	38.46 %
3	6	60 %
4	6	85.71 %

In Babies with IVH in 71.86 % of babies (42 babies), IVH was found before day 3 of life and in only one baby IVH was seen after 1 week.

In our study all babies who showed IVH by CT Scan were also shown to have IVH by USG through Af. In patients in whom IVH was suspected but USG through AF was normal, in such patients CT Scan was done, but CT scan also did not show IVH in all such patients in the present study.

## DISCUSSION

A landmark study was done by Papile et al in 1978. He documented that IVH was present in 45 % of LBW (< 1500 gms) neonates born before 30 weeks gestation. [11]

Currently the incidence is 15 – 20 % in infants born at < 32 weeks of gestational age. According Szymonowicz et al (1986) and strand et al (1990) the incidence is 15 – 20 %. [12] In our study incidence of IVH was found to be 10.82 %

According to Rolland and Hill study made in 1997, IVH is identified in

approximately 20 % of premature newborns with birth weight of < 1.5 kg. and in more than half of premature newborns with birth weight between 500 to 700 gms. [13]

In our study majority of IVH babies i.e. 38 (66.6%) had birth Weight < 1Kg.

According to Harding JE et al (2001) the wide spread use of antenatal steroids has made to decrease incidence to 15-20%. [14]

In our study out of 59 patients with IVH 46 patients had not received antenatal steroids i.e. steroids taken by mother during Antenatal care seemed to have beneficial effect as seen above.

Neonatal sepsis predisposes to longer NICU stay and thus more chances of factors like alternating cerebral blood flow and fluctuating BP which are known risk factors for development of IVH.

In various post natal events in our study desaturation was found in 25 % of patients and fluctuation in BP was found in 17.3 %. Also delayed cry was observed in 19.1 %. This incidence of IVH is in similar to that found by Dubowitz et al (1981), [15] Moylan FM et al (1978) and a randomized trial conducted in 1997. [16]

Mortality rate increases with increasing grades of IVH. Similar rates of mortality were found in study done by Ahmann Peter A et al. [17] So rigorous monitoring and screening with neurosonography is very essential once grade 1 IVH is detected in neonate. Also the prognosis is poor and has to be explained to the relatives as grades of IVH increase.

## CONCLUSION

The present study was conducted to find out the incidence of Intracranial hemorrhage in preterm neonates and to evaluate risk factors associated with IVH. Also it aims to establish reliability of neurosonography in diagnosis of IVH.

The incidence of IVH was found to be 10.82 % in our study and about most of the babies was in a gestational age of 25 – 32 weeks and gestational age of 26 – 28 weeks was found to be a significant risk factor for IVH.

In our study not receiving antenatal steroids, was found as risk factor for IVH. Events of desaturation are seen in one-fourth of babies with IVH. All patients with grade 4 IVH had seizures while no patients with grade I IVH had seizures. Incidence of mortality was high with grade 4 IVH. As it can be clearly seen mortality increases steadily as grades of IVH increase.

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