Research Paper Management

Incidence of Acute Kidney Injury in Perinatal Asphyxia and its Correlation with Hypoxic Ischemic Encephalopathy (HIE) Staging

*** Ambar Bhatnagar**	Resident, Dept. of pediatrics, GMC, Kota. * Corresponding
A. L. Bairwa	Professor, Dept. of pediatrics,GMC, Kota.
K. C. Meena	Professor, Dept. of pediatrics,GMC, Kota.

ABSTRACT

A prospective case control study was conducted in the NICU of a tertiary level referral teaching hospital Dept. Of Pediatrics, J. K. Lone Mother and Child Hospital, Kota to determine the Incidence of Acute Kidney Injury in asphyxiated neonates and to correlate severity of Kidney Injury with hypoxic ischemic encephalopathy (HIE) grading. 110 neonates were enrolled–60 asphyxiated babies and 50 healthy controls. Both the groups were statistically similar in gender distribution (p=0.93), birth weight (p=0.85), age and length distribution (p=0.286). Renal functions were assessed using urinary output, biochemical parameters(B. Urea , S. Creatinine) and sonographic findings. Babies having Kidney Injury were managed on a protocolised plan.

Blood urea (28.65±12.12 vs20.78±9.91) and serum creatinine (1.15±0.35 vs0.72±0.21) were significantly higher (p<0.001) in asphyxiated babies compared to the control group. Biochemical derangements correlated well with HIE staging. There was no significant difference in urine output in the control and the study group as significant oliguria was seen in only 11 of the 60 asphyxiated babies and the output did not correlate with severity of asphyxia. Of the 60 asphyxiated -babies 37 (61.66%) had renal failure where as in control only 1 out of 50(2%) had renal failure i.e. significantly more in asphyxiated babies (X^2=40.342; p<0.001. Renal failure was of the non-oliguric type in (26/37) 70.27% cases and oliguric type in (11/37) 29.72% cases. Mortality was higher in babies with oliguric renal failure. We conclude that AKI is a significant problem in asphyxiated neonates with majority of babies having non-oliguric failure. Severity of renal function abnormality correlates well with degree of asphyxia and HIE Staging.

KEYWORDS Birth asphyxia, Hypoxic ischemic encephalopathy, Acute Kidney Injury.

Introduction:

According to latest estimates by World Health Organization (WHO), approximately 4 million babies die each year before they reach the age of one month(1). Ninety-eight percent of these neonatal deaths take place in the developing countries. Perinatal asphyxia and birth injuries together contribute to almost 29% of these deaths(1). A gold standard definition of birth asphyxia does not exist. It is probably better to use the term perinatal asphyxia since asphyxia may occur in utero, at birth or in the postnatal period. WHO(2) has defined perinatal asphyxia as a "failure to initiate and sustain breathing at birth" The National Neonatal Perinatal Database (NNPD), 2000 used a similar definition for perinatal asphyxia(3).

Birth asphyxia is an eventually having far reaching consequences in the neonatal period. Overall incidence of asphyxia is reported to vary from 1 to 1.5% at various centers and is related to birth weight and gestational age of the baby(4). Perinatal asphyxia leads to multi-organ dysfunction. Virtually any organ can be affected. And care in the nursery should be oriented to determining the presence or the absence of dysfunction of the critical organ systems.. Many of these complications are potentially fatal. In term infants with asphyxia, renal, CNS, cardiac and lung dysfunction occur in 50%, 28%, 25% and 25% cases, respectively(5).As kidneys are very sensitive to oxygen deprivation, renal Insufficiency may occur within 24 hours of a hypoxic ischemic episode, which if prolonged, may even lead to irreversible cortical necrosis. Early recognition of renal failure is important in babies with HIE to facilitate appropriate fluid and electrolyte management as a stable biochemical milieu is vital. Diagnosis of renal failure is difficult in neonate as many of the established clinical and biochemical parameters are unreliable in this age group. We had performed this study to determine the incidence of Acute Kidney Injury in Birth Asphyxia and to correlate the severity of Kidney Injury with the HIE grading of asphyxiated neonate to mainly emphasize on early diagnosis of disturbed neonatal kidney function and also on therapeutic aspects which may be of a particular benefit for asphyxiated newborns at high risk for developing acute kidney injury.

Aims And Objectives:

- To determine the incidence of Acute Kidney Injury in Term asphyxiated neonates.
- To correlate severity of Acute Kidney Injury with Hypoxic Ischemic Encephalopathy (HIE) staging of the asphyxiate neonates.

Method:

All term asphyxiated neonates (as per WHO Definition) and 50 term normal neonate born in J. K. Lone Mother and Child Hospital Kota during the study period Sept. 2012 – Aug. 2013 were taken as case and control. Normal term (37-42weeks) neonate were selected as controls by using stratified random sampling. Neonate with confounding factors believed to alter renal functions such as septicemia, Respiratory Distress Syndrome, Necrotizing enterocolitis, major congenital anomalies, on IV nephrotoxic drugs, h/o maternal drug intake, h/o maternal fever, gestational age <37 weeks / >42 weeks are excluded from the study. Gestational age, birth weight, relevant history , examination findings was recorded in predesigned proforma

The post asphyxiated neonate will be managed accordingly:

Initial Management:

The initial management of all such neonate was consisted of placing the baby under a servo controlled radiant warmer and nursing them in the thermo neutral range of temperature. Immediate clinical assessment was made by recording respiratory rate , heart rate, capillary filling time, blood pressure, temperature and oxygen saturation .

Intravenous line was secured and IV fluids was started 10%dextrose at 60 ml/kg/day on day 1, 75ml/kg/day on day 2,90ml/kg/day on day 3, 105 ml/kg/day on day 4, 120 ml/kg/day on day 5, 135 ml/kg/day on day 6, 150 ml/kg/day on day 7 with additional allowance of 20 ml/kg/day for radiant warmer. For first 48 hrs dextrose 10% and then after isolyte-P was given(7). Injection Vitamin K 1 mg was administered to all these babies. A stomach wash was performed if there is history of meconium stained liquor.

All neonate who had suffered asphyxia was closely Monitored clinically. This monitoring aimed to detect derangements in the clinical, metabolic and hemodynamic milieu so as to ensure prompt management. Seizure was treated energetically. After 72 hours of birth and before 96 hours of birth(8), after obtaining informed written consent from the parents, under aseptic precautions 3 ml blood was drawn and was evaluated for blood urea (Berthelot method)(9), serum creatinine (Jaffe's test)(10). 24 hr urine output was monitored by applying plastic collection bag.

Criteria adopted for defining Acute Renal Failure in Neonate is Oliguria <1ml/kg/hr or serum creatinine of more than 2 SD above the mean value for gestational age(8) which is more than 1.15mg/dl.BUN of >20mg/dl is useful indicator of ARF(11).

Those neonate who were fulfilling the above criteria was diagnosed as ARF, and was managed by giving a fluid challenge 20ml/kg of normal saline & monitored for urine output, it urine output was <1ml/kg/hr they were given diuretic injection frusemide 1mg/kg and still if urine output is <1ml/kg they were labeled as Intrinsic renal failure and was managed accordingly.(8)

Results:

37/60 cases had AKI (61.66%) as compared to control 1/50 (2%) which was statistically significant (p<0.001). All control were nonoliguric , and among the cases 11/60 (18.3%) were oliguric and 49/60(81.6%) were non oliguric, and among the cases who were non oliguric experienced AKI. Based on type of renal involvement 31 (83.7%)had prerenal AKI, and 6 (16.2%) had renal AKI.

12/31(38.7%) HIE I Cases, 19/23(82.6%) HIE II Cases and 6/6 (100%) HIE III cases Had ARF (p<0.001). That suggest That Incidence of AKI Increases significantly with HIE Staging.

There Was a significant increase in Mean values of blood urea and S. Creatinine as the HIE stage progressed.

Incidence of shock in AKI (8/37) was found to be statistically insignificant (p=0.147) in our study.

Table No. I Incidence Of AKI in Perinatal Asphyxia

ARF	Control(50)	Cases(60)
Present	1(2%)	37(61.66%)
Absent	49(98%)	23(38.33%)

X^2= 40.342; P<0.001.(significant)

Table No. II Correlation Between Incidence of AKI with HIE Staging

HIE	NO.	ARF	Pre Renal	Renal	Oliguric	NonOliguric
I	31	12(38.7%)	12(100%)	0	4(33.3%)	8(66.6%)
II	23	19(82.6%)	18(94.7%)	1(5.2%)	5(26.3%)	14(73.6%)
III	6	6(100%)	1(16.6%)	5(83.3%)	2(33.3%)	4(66.6%)
Total	60	37	31	6	11	26
		P value= <0.001 (significant)				

Discussion:

Kidney injury in birth asphyxia is a potential consequence of adaptive mechanism. Amongst the recognized complications (i.e., acute tubular necrosis, renal vein thrombosis and renal failure), AKI is the commonest and carries a poor prognosis and may even result in permanent renal damage in up to 40% of survivors(11).

Urinary output was slightly less in neonates with severe birth asphyxia but it was statistically insignificant when compared with cases of mild and moderate asphyxia. Non-oliguric renal failure is a recognized entity secondary to perinatal asphyxia. Heterogenous response of individual nephron and variable damage to tubular epithelium results in anatomical damage in majority of nephrons leading to reduction in single nephron GFR and decreased tubular fluid flow. But if damage to tubular epithelium is less severe there occurs decrease in fractional reabsorption which exceeds the decrease in single nephron GFR leading to polyurea in non-oliguric renal failure(12).

Obstruction of tubular lumen and back leak mechanism contributed to increase in urea and creatinine levels in asphyxiated neonates and other authors too noted great correlation between severity of HIE and ischemic damage to the kidneys manifesting as ARF(13).A reduction in number of functional nephrons caused by asphyxia and leading to ARF evokes compensatory hypertrophy of the residual nephrons thus leading to improved renal functions in early months of life. But whether subtle defects may persist, can be said only after long term follow-up and one must be cautious in prognosticating these neonates.

REFERENCES

1. Costello A, Francis V, Byrne A, Puddephatt C. State of the world's newborns. Kinetik communications 2001. | 2. World Health Organizaton. Perinatal mortality: a listing of available information.FRH/MSM.96.7.Geneva:WHO,1996 | 3. Report of the National Neonatal Perinatal Database (National Neonatology Forum,India) 2000 | 4. Aurora S, Snyder EY, Perinatal asphyxia. In: Cloherty JP, Stark Ann R. eds. Manual of Neonatal Care. 4th edn. New York: Lippincott, Williams & Wilkins; 1997, pp 536-555. | 5.Perlman JM, Tack ED, Martin T, Shackelford G, Amon E. Acute systemic organ injuryin term infants fter asphyxia. Am J Dis Child 1989;143:617-20 | 6. Misra PK et al,outcome in relation to Apgar score in term neonate. Indian Pediatrics 1991 oct.;31:1215-18 | 7. Chawla D, Agarwal R, Deorari AK,Paul VK. Fluid & Electrolyte management in term & preterm neonates. Indian J Pediatr.2008;75:255-9. | 8. John P. Cloherty, Eric C. Eichenwald, Anne R. Hansen, Ann R.Stark Manual of Neonatal Care. Seventh Edition: Lippincott Williams &Wilkins;2012. pp 359-66,711-19. | 9. Thomas L. Clinical Laboratory Diagnostics. 1st ed. Frankfurt: TH-Books Verlagsgesellschaft; 1998. p. 374-7. | 10. Henry, R.J., Clinical chemistry, Principals & Techniques, 2nd Edition, Harper and Row p.525,1974. | 11. Meherban Singh. Care of Newborn; seventh edition; sagar publication; 2010. pp97,323. | 12. Martin-Ancel A, Garcia-Alix A, Goya F, Cabanas F, Buergueros M, Guero J. Multiple organ involvment in perinatal asphyxia. J Pediatr 1995; 127: 786 -793. | 13. Bailie MD. Renal function and disease. Clin Perinatol 1992; 19: 91-92. |