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Research Article

Incidence of multiorgan dysfunction in perinatal asphyxia

Ramesh S. Pattar*, Anil Raj, Bhuvaneshwari Chandrashekhar Yelamali

Department of Paediatrics, S.N Medical College, Bagalkot, Karnataka, India

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***Correspondence:**
Dr. Ramesh S. Pattar,
E-mail: drrameshpattar@gmail.com

ABSTRACT

Background: Objectives of current study was to study the incidence of multiorgan dysfunction in babies with perinatal asphyxia and its effect on the outcome.
Methods: All term babies admitted to NICU of S. Nijalingappa Medical College and Hanagal Shri Kumareshwara Hospital, Bagalkot in the period January 2013 to December 2013 with perinatal asphyxia and HIE were included in the study. Detailed history and thorough examination was done using predesigned and prestructured proforma. Necessary investigations were done as indicated to identify organ dysfunction.
Results: 80.8% of babies with perinatal asphyxia had evidence of multiorgan dysfunction with HIE alone seen in 19.2% of cases. Respiratory failure was the most common organ dysfunction after CNS seen in 63.1% of cases. CVS involvement was seen in 54.3% (31) of babies, out of which the mortality was seen in 22.5% (7 cases), renal involvement was seen in 29.8% (17) of babies, out of which the mortality was seen in 29.4% (5 cases). Increased mortality in babies who had cardiovascular dysfunction and in babies with renal dysfunction was statistically significant. Mortality was higher in babies with multiorgan dysfunction which increased proportionately with increase in number of organs involved.
Conclusions: Multiorgan dysfunction is common in babies with perinatal asphyxia. Cardiovascular involvement and renal involvement are associated with poor outcome. Mortality is directly proportional to the number of organs involved.

Keywords: Perinatal asphyxia, Hypoxic ischemic encephalopathy, Multiorgan dysfunction

INTRODUCTION

Birth asphyxia refers to condition of hypoxemia, hypercapnia and insufficient blood perfusion of new born during labour and birth. NNPD defines moderate birth asphyxia as APGAR score of 4-6 at 1minute and severe birth asphyxia as APGAR score of <3 at 1 minute.[1] AAP defines it as APGAR score of less than 3 at 5minutes associated with cord pH of less than 7.0, presence of neurologic dysfunction and evidence of multiorgan dysfunction.[2]

Perinatal Asphyxia (PA) is a major public health problem. As per the latest estimates, PA accounts for 9% (i.e. 0·8 million) of total under-5 mortality (i.e. 8.8 millions) worldwide, being one of the three most common causes of neonatal deaths along with prematurity and bacterial infections. Of a total of 2.7 million stillbirths globally, approximately 1.2 million occur during intrapartum period, largely owing to asphyxia.[3] As per NNPD, 9.5% of babies require some form of resuscitation. Manifestations of Hypoxic Ischaemic Encephalopathy (HIE) were seen in approximately 1.4% of all babies. PA was responsible for 28.8% of all neonatal deaths. Apart from neonatal deaths, asphyxia is responsible for life-long neuromotor disability in a large number of children.[1]

Asphyxia can cause damage to almost every tissue and organ of the newborn baby, the target organs for dysfunction due to asphyxia insult being the brain, heart, lungs, kidneys, liver, bowel and bone marrow. The degree of severity of the asphyxia determines the number of organs damaged, and the severity of damage to the organs involved.[4-6]

Even though the involvement of multiple organs in severe birth asphyxia is known, there are not many studies in which the effects of birth asphyxia on multiple organs have been evaluated. Most of the studies performed on neonates suffering a severe asphyxial insult have evaluated the effects of birth asphyxia on the central nervous system.

A few studies have been performed on involvement of systems other than central nervous system, but in most of these studies either a single organ or two organs have been studied to evaluate the effects of birth asphyxia. There is very less Indian data available on the effects of birth asphyxia on various organs of the body In view of all these points, the purpose of this study is to evaluate the immediate effects of severe birth asphyxia in term neonates on various organs of the body and its effect on the outcome.

METHODS

Source of data

All term neonates admitted in neonatal critical care unit of Department of Pediatrics, S. Nijalingappa Medical College and HSK Hospital, Bagalkot from January 2013 to December 2013 with history suggestive of perinatal asphyxia with 5 minute APGAR score of less than 5 or babies with delayed initiation of respiration of more than 5 minutes with evidence of hypoxic ischemic encephalopathy at admission (for babies where APGAR score was not available) were included in the study. Babies who were born preterm and those with evidence of sepsis were excluded from the study.

Detailed birth history and examination findings were recorded as per the predesigned and prestructured proforma.

Necessary investigations to identify the multiorgan dysfunction like CBC, blood urea, creatinine, liver enzymes, PT, APTT, INR, X-ray chest, ABG, echocardiography etc. as per the protocol were done. Other investigations were done as necessary. Babies were monitored and treated as per standard protocol according to the clinical condition.

Organ dysfunction was defined as follows

CNS: evidence of hypoxic ischemic encephalopathy as per Sarnat and Sarnat staging.

Renal failure: Oliguria <1 ml/kg/hour for more than 24 hours or serum creatinine of more than 1.2 mg/dl. Blood samples for serum creatinine were obtained at around 48 hours of age.

Respiratory system: Hypoxia with or without hypercapnia or need for oxygen to maintain spo2 >92% for >24 hour or requirement for mechanical ventilation.

Cardiac dysfunction: Signs of poor perfusion like prolonged Capillary refill time, poor pulses, tachycardia with or without hypotension or inotrope requirement to maintain normal perfusion or unexplained metabolic acidosis with base excess of more than 5 meq/L.

Gastrointestinal evaluation: Evidence of NEC in the form of GI bleed, abdominal distension, gastrointestinal residues and X-ray showing signs of NEC.

Hepatic dysfunction: Elevation of aspartate aminotranferase (SGOT) or alanine aminotranferase (SGPT) of more than 100 IU/L. Blood samples were taken between 2^{nd} & 5^{th} day of life.

Hematological dysfunction: INR >1.5 & platelet count less than 1 lakh/mm^3. Blood samples were taken between 2^{nd} & 5^{th} day of life.

RESULTS

Total of 57 babies were included in the study. Out of these 57 babies, 41 (71.9%) were males and 16 (28.1%) were females. 78.9% (45) of babies from rural area 21.1% (12) of babies were from urban area. 91.2% babies were term babies and 8.8% babies were post term. Majority of these babies (91.2%) were admitted on day 1 of life. 26.3% (15) were inborn and 73.7% were outborn. There were no home deliveries. 36.8% of the babies were delivered by LSCS and 63.2% were delivered vaginally.

Respiratory system was the most frequently involved (seen in 63.1% of cases) other than central nervous system. Hematological system was the least involved and was seen in 5.2% of cases. Multiorgan dysfunction was seen in 80.8% of cases. With increase in organ dysfunction there was proportionate increase in mortality (Table 1 and 2).

Table 1: Frequency of organ involvement.

Organ involvement	Percent
CNS	100% (57)
RS	63.1% (36)
CVS	54.3% (31)
Renal	29.8% (17)
Liver	24.5% (14)
GIT	17.5% (10)
Hematological	5.26% (3)

Table 2: Multiorgan dysfunction and its outcome.

Organ dysfunction	Improved	AMA	Death
1	10	1	0
2	13	3	1
3	8	3	2
4 or more	5	6	5
Total (n=57)	36	13	8

CNS involvement was classified according to Sarnat & Sarnat staging. 33% (19) babies belonged to HIE stage-1, 50.9% (29) belonged to HIE stage-2 and 15.8% (9) belonged to HIE stage-3. Mortality was 5.2% (1 case) with HIE stage-I, while 84.2% (16 cases) improved. In HIE stage-II, the mortality was 10.3% (3 cases) and 68.9% (20 cases) improved. HIE stage-III had the highest mortality 44.4% (4 cases) and 55.5% (5) babies who got discharged against medical advice were critically ill. The association between HIE staging & outcome was highly significant (P=0.0001) (Table 3).

Respiratory involvement was seen in 63.1% (36) of babies, out of which the mortality was seen in 19.4% (7 cases). 31.6% (18) babies required ventilator support out of which 38.8% (7) babies died & 11.1% (2) babies improved and remaining got discharged against medical advice. CVS involvement was seen in 54.3% (31) of babies, out of which the mortality was seen in 22.5% (7 cases), while 45.1% (14 cases) improved. Renal involvement was seen in 29.8% (17) of babies, out of which the mortality was seen in 29.4% (5 cases), while 41.1% (7 cases) improved. GIT involvement was seen in 17.5% (10) of babies, out of which the mortality was seen in 30% (3 cases), while 40% (4 cases) improved. Liver involvement was seen in 24.5% (14) of babies, out of which the mortality was seen in 14.2% (2 cases), while 50% (7 cases) improved. Hematological abnormality was seen in 5.26% (3) of babies, out of which none of the babies died (Tables 4 and 5).

The association between poor outcome and renal and cardiovascular involvement was statistically significant (P=0.04 and 0.008 respectively). There was no statistically significant association between poor outcome and liver, GIT and haematological involvement.

Table 3: HIE staging & its outcome.

		Outcome			Total
		Improved	AMA	Death	
CNS HIE staging	1	16 (84.2%)	2 (10.5%)	1 (5.2%)	19 (33.3%)
	2	20 (68.9%)	6 (20.6%)	3 (10.3%)	29 (50.8%)
	3	0 (0%)	5 (55.5%)	4 (44.4%)	09 (15.7%)
Total		36 (63.15%)	13 (22.8%)	8 (14%)	57 (100%)

Table 4: Organ dysfunction and its outcome.

Organ dysfunction	Improved	AMA	Death	Total
RS				
Present	15 (71.4%)	5 (23.8%)	1 (4.7%)	21 (36.8%)
Absent	21 (58.3%)	8 (22.2%)	7 (19.4%)	36 (63.1%)
CVS				
Present	22 (84.6%)	3 (11.5%)	1 (5.2%)	26 (45.6%)
Absent	14 (45.1%)	10 (32.2%)	7 (22.5%)	31 (54.3%)
GIT				
Present	32 (68%)	10 (21.2%)	5 (10.6%)	47 (82.4%)
Absent	4 (40%)	3 (30%)	3 (30%)	10 (17.5%)
Liver				
Present	29 (67.4%)	8 (18.6%)	6 (13.9%)	43 (75.4%)
Absent	7 (50%)	5 (35.7%)	2 (14.2%)	14 (24.5%)
Renal				
Present	29 (72.5%)	8 (20%)	3 (7.5%)	40 (70.1%)
Absent	7 (41.1%)	5 (29.4%)	5 (29.4%)	17 (29.8%)
Haematological				
Present	35 (64.8%)	11 (20.3%)	8 (14.8%)	54 (94.7%)
Absent	1 (33.3%)	2 (66.6%)	0 (0%)	3 (5.26%)

Table 5: Outcome of ventilated babies.

		Outcome			Total
		Improved	AMA	Death	
Ventilator	Not used	34 (87.1%)	4 (10.2%)	1 (2.5%)	39 (68.4%)
	Used	2 (11.1%)	9 (50%)	7 (38.8%)	18 (31.6%)
Total		36 (63.1%)	13 (22.8%)	8 (14.1%)	57 (100%)

DISCUSSION

Multiorgan dysfunction is part of perinatal asphyxia which occurs due to diving reflex wherein there is redistribution of blood flow to vital organs like brain, heart and kidneys. With continued asphyxia there is hypotension, loss of autoregulation of blood flow to brain and loss of compensatory mechanisms resulting in severe hypotension, hypoxic and ischemic injury even to the vital organs. Organs suffering hypoxic and ischemic injury develop dysfunction and failure if this hypoxia-ischemia is not corrected. Hence degree of multiorgan dysfunction would directly correlate with severity of asphyxia. Multiorgan dysfunction increases the risk of morbidity and mortality. Kidney is the most common organ to be affected in perinatal asphyxia other than brain.[4] HIE occurred without accompanying multiorgan dysfunction was seen in 24.5% of cases in a study involving 57 cases.[7]

In our study HIE alone was seen in 19.2% of cases. Remaining 80.8% cases had evidence of multiorgan dysfunction. Respiratory system was the most commonly involved organ other than CNS with 63.1% cases showing respiratory involvement followed by CVS. Studies by Shah P et al.[8] and Shakaran Seetha et al.[9] showed similar findings whereas in studies conducted by Low James A et al.[10] and Mohammed LH et al.[11] renal dysfunction was most commonly observed after CNS involvement.

In our study, 78.9% of babies were from rural area. This signifies the need to improve appropriate health care facilities in rural area to prevent birth asphyxia.

Brain is the most common organ involved in birth asphyxia and its involvement manifests as hypoxic ischemic encephalopathy. Encephalopathy can be mild (HIE stage 1), moderate (HIE stage 2) and severe (HIE stage 3). Babies with HIE stage 1 have 100% survival and no or minimal deficits if any. Mortality in babies with HIE stage 2 can vary from 10-15%. 50% of babies with HIE stage 3 die and the remainder usually have sequelae.[12] In our study majority (50.9%) of the babies were found to be in HIE stage 2. Mortality correlated directly with severity of encephalopathy with 44.4% of babies having HIE stage 3 died. Similar findings were observed in studies by Martin Ancel Ana et al.[13] and Shankaran Seetha et al.[9]

Mortality increased proportionately in babies with involvement of cardiovascular system so was with babies having renal system involvement. In contrast presence of respiratory failure, dysfunction of GIT, liver dysfunction and haematological abnormalities did not correlate directly with poor outcome.

22.5% neonates with evidence of cardiovascular dysfunction died during the study period. In the study by Shah P et al.[8] death or adverse outcomes were seen in 64% of those with Cardiovascular involvement, while Agrawal J et al.[14] noted mortality in 32% cases. Laila H. Mohammed et al.[11] reported 76.1% of mortality. Gonzalez et al.[15] found increased neurological morbidity with cardiovascular dysfunction. In the present study, mortality rate of 29.4% was noted in neonates with renal involvement which was comparable with most other studies.[16-18]

Multiorgan dysfunction was seen in 80.8% of cases. With increase in number of organ dysfunction there was resultant poor outcome. Babies with 4 or more organ dysfunction had the worst outcome with mortality seen in 31.25% babies and 37.5% babies got discharged against medical advice in view of poor outcome and cost constraints as most of these babies required prolonged NICU stay. Most other studies found correlation between individual organ involvement and outcome. Study by Shah P et al. did not find any relation between multiorgan dysfunction and outcome.[6] Similar studies on incidence of multiorgan dysfunction in babies with perinatal asphyxia did not study the relation between number of organs involved and outcome.[6,11,19]

CONCLUSIONS

Following conclusions can be drawn from the above study.

1. Multiorgan dysfunction is a common finding in babies with birth asphyxia
2. Morbidity and mortality correlates directly with stage of HIE.
3. Cardiac and renal dysfunction in babies with perinatal asphyxia is associated with poor outcome.
4. Mortality increases proportionately with the number of organs involved.

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