

## Case Study



## Case Study on Hypoxic-Ischemic Encephalopathy with Severe Birth Asphyxia

K Shailaja\*<sup>1</sup>, Sowndharya S<sup>2</sup>, Sneha Mavis M<sup>2</sup>, Tharani A<sup>2</sup>, Preethi P<sup>2</sup>

1.\*Asso. professor, C L Baid Metha College of Pharmacy, Affiliated to “The Tamilnadu Dr. MGR Medical University”, Thoraipakkam, Chennai – 97, Tamilnadu, India.

2. Pharm.D Student, C L Baid Metha College of Pharmacy, Affiliated to “The Tamilnadu Dr. MGR Medical University”, Thoraipakkam, Chennai – 97, Tamilnadu, India.

\*Corresponding author’s E-mail: [shailajampharm@gmail.com](mailto:shailajampharm@gmail.com)

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### ABSTRACT

**Introduction:** Hypoxic-Ischemic Encephalopathy (HIE) is a type of brain dysfunction that occurs when the brain doesn’t receive enough blood flow for a while. It may develop during pregnancy, labor and, delivery or in the postnatal period.

**Chief complaints:** A 32-year-old gravida 6 para 6 patient (G6P6), came to the hospital with chief complaints of leaking, underwent emergency cesarean section due to severe fetal distress. A male baby was delivered flat, apneic, cyanosed, and with no heart rate. The 5-minute Apgar score was 3 and admitted to the neonatal intensive care unit.

**Investigations:** Brain MRI revealed profound Hypoxic-Ischemic Encephalopathy. Cranial Ultrasound revealed dilated lateral ventricles. Abdomen Ultrasound was normal. Complete blood count, chemistry studies, blood gas values, and oximetry values were also taken.

**Diagnosis:** From the above investigations, the infant was diagnosed with Hypoxic Ischemic Encephalopathy with severe birth asphyxia.

**Treatment:** Therapeutic Hypothermia was initiated after attempting endotracheal tube cardiopulmonary resuscitation and the heart rate was recovered above 100 and followed by antiepileptic drugs. Syp.Keppra, T. Phenobarbitone, Rivotril drops, and Ventolin nebulizer were administered.

**Keywords:** Hypoxic-Ischemic Encephalopathy, Asphyxia, Apgar, Therapeutic hypothermia, Cardio-Pulmonary Resuscitation.

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### INTRODUCTION

Hypoxic-Ischemic Encephalopathy (HIE)<sup>1, 2</sup> is characterized by clinical and laboratory findings of acute or subacute brain injury due to severe asphyxia. Severe Hypoxic-Ischemic Encephalopathy is characterized by seizures that are initially resistant to conventional treatments. Stupor or coma is typical, breathing may be irregular and the infant will often need ventilatory support. Generalized hypotonia and deep tendon reflexes are often depressed and neonatal reflexes are absent. The clinical diagnosis is made based on the evidence which includes the Apgar scoring system,<sup>3</sup> imaging techniques<sup>4-8</sup>, and other laboratory techniques. The conventional treatment modalities available for the treatment of HIE include neonatal resuscitation<sup>9</sup>, therapeutic hypothermia<sup>10</sup> to slow down the injury process, providing time for the brain to heal, anticonvulsants for the seizures, broad-spectrum

antibiotics as prophylactic measures for nosocomial infections among others.

HIE occurs when the brain doesn’t receive enough blood flow for a while. It may develop during pregnancy, labor, and delivery or in the postnatal period. The potential causes of HIE during labor and delivery include umbilical cord problems, abruption of the placenta or rupture of the uterus, excessive bleeding, abnormal fetal position among others. The infants born with HIE may encounter one or more of these problems which include severe prematurity, severe lung or heart disease, serious infections, trauma to the brain or the skull, very low blood pressure, or respiratory and cardiac arrest.

### Pathophysiology of Hypoxic-ischemic Encephalopathy<sup>11</sup>

The common underlying processes involved in the pathogenesis of Hypoxic-Ischemic Encephalopathy are hypoxia (reduced blood oxygenation) and ischemia (diminished cerebral blood flow). With prolonged hypoxemia, cardiac hypoxia occurs leading to diminished cardiac output which ultimately results in cerebral ischemia.

Thus, the brain damage caused by asphyxia is a result of ischemia combined with hypoxia. It is a well-known fact that the hypoxic-ischemic insults do not affect all the brain structures uniformly. Rather certain tissues are likely to be injured, a phenomenon is known as selective vulnerability.



Brain ischemia results in a switch from oxidative phosphorylation to anaerobic metabolism which is highly inefficient and causes rapid depletion of ATP and lactate accumulation within the cells. This results in the eventual loss of normal cellular metabolism.

Depolarization of the presynaptic neuronal cell membrane causes a massive release of excitatory neurotransmitters, especially glutamate. In the immature brain, glutamate binds with NMDA receptor-mediated calcium channels. Activation of which causes a massive influx of calcium ions in the post-synaptic neurons, triggering several cytotoxic pathways. Activation of membrane phospholipases and production of oxygen free radicals are the two most important cytotoxic pathways that further damage the mitochondria resulting in further loss of ATP and energy depletion.

The energy depletion can cause either of the following pathways that result in the death of neurons

- Severe energy depletion can cause rapid cell death in a process called necrosis.

### Investigations

#### Apgar score

Parameter	0	1	2	1 min	3 min	5 min	10 min
Respiratory rate	Absent	Slow irregular	Good crying	0	0	0	0
Heart rate	Absent	Below 100	Over 100	0	2	2	2
Colour	Blue-pale	Pink body, blue extremities	Completely pink	0	0	1	1
Muscle tone	Limp	Some flexion	Active motion	0	0	0	0
Reflex irritability	No response	Grimace	Cry	0	0	0	0
TOTAL				0	2	3	3

- BRAIN MRI – It revealed profound Hypoxic Ischemic Encephalopathy and showed increased signal intensity at thalami and lentiform nuclei as well as an abnormally high signal in parietal grey matter. The increased intensity indicates pathological processes like infection, Hypoxic-Ischemic injury, tumor, or areas of demyelination. These MRI features are in favor of profound HIE.
- TRANS-CRANIAL ULTRASOUND – It revealed dilated both lateral ventricles and no germinal matrix hemorrhage.
- ABDOMEN ULTRASOUND – It was normal.
- BLOOD GAS –
  - ◆ pO<sub>2</sub> values were low 68.2mmHg
  - ◆ pCO<sub>2</sub> values were normal 36.5mmHg
  - ◆ pH was low with values of 7.343

- During a lesser extent of energy depletion, the neurons survive the initial insult and undergo a delayed form of programmed cell death called apoptosis, which plays a significant role in injury to the immature brain.

### Chief Complaints

A 32-year-old G6P6 patient came to the hospital with chief complaints of leaking. The patient underwent an emergency cesarean section due to severe fetal distress. The male baby was delivered flat, apnoeic, cyanosed, and with no heartbeat. The neonate was assessed and Apgar scores were also measured. The 5-minute Apgar score of the neonate was 3 and was admitted to the neonatal intensive care unit.

### Medical and medication history

The mother had 6 pregnancies which she carried for the full term.

Parameter	Observed value	Reference value
MCV	116.20fl	102-115fl
Creatinine kinase	131U/L	0-24U/L
Sodium	128mmol/L	133-145mmol/L
Urea	6.8mmol/L	0.7-6.7mmol/L
Prothrombin time	16.90 seconds	10-15 seconds
Albumin	20.60g/L	35-49 g/L
C-Reactive protein	positive	

### Clinical Diagnosis

The clinical diagnosis was made based on the evidence of

- ❖ Fetal distress
- ❖ Low umbilical cord pH
- ❖ A low Apgar score of 3 at 5 minutes.
- ❖ Necessity for resuscitation
- ❖ Abnormal neurology like seizure and hypotonia



The mother was admitted to the hospital with severe fetal distress due to an antepartum hemorrhage. The umbilical cord pH was 6.5 and the 5-minute Apgar score was 3. The infant was delivered flat and apnoeic. The neonate was resuscitated through Endotracheal tube cardio-pulmonary resuscitation and positive pressure ventilation was provided. The neonate developed an attack of convulsion. The MRI and US findings revealed profound Hypoxic Ischemic Encephalopathy and dilated both lateral ventricles.

Based on the above evidence the infant was diagnosed with Hypoxic Ischemic Encephalopathy due to severe birth asphyxia.

#### Treatment

• ENDOTRACHEAL TUBE – CARDIO-PULMONARY RESUSCITATION was attempted and the heart rate was recovered above 100. Positive pressure ventilation via a

face mask was initiated. Chest compressions were initiated with continued Positive Pressure Ventilation with 100% oxygen at a 3:1 ratio.

• THERAPEUTIC HYPOTHERMIA was initiated promptly to slow down the injury process, allowing the neonate's brain to heal and to minimize the spread of damage. Therapeutic hypothermia helps slow down the injury process associated with HIE. It involves cooling the neonate down to 33.5-34.5°C for 72 hours, within 6 hours of birth or oxygen depriving event. Following hypothermia, the body is re-warmed slowly over at least 4 hours at a rate of 0.5°C per hour until they are at 36.5-37.0°C. Lowering the body temperature slows the metabolic rate and allows the cells more time to recover from the neurological damage. Therapeutic hypothermia was carried out using cooling blankets and cooling caps. The temperature was brought down to 33.5°C and it was held for 72 hours. The neonate was re-warmed back to 37°C over 7 hours.

Brand name	Generic name	Dose	Route	Frequency	Duration
Syp.Keppra	Levetiracetam	100mg	PO	BID	10 days
T.Phenobarbitone	Phenobarbitone	12.5mg	PO	BID	10 days
Rivotril drops	Clonazepam	2 drops	PO	BID	10 days
Ventolin nebulizer	Salbutamol	2 ml	Nebulizer	QID	7 days
Vancomycin	Vancomycin	50 mg	IV	Q8H	7 days
Tienam	Imipenem+ Cilastatin	100mg	IV	BID	7 days

#### Treatment Outcomes

After the Endotracheal tube Cardio Pulmonary Resuscitation, the neonate was stable and the vitals were brought back to normal. The heart rate was brought above 100. The neonate was kept under round-the-clock monitoring. Anti-epileptics were given for the treatment of seizures. Broad-spectrum antibiotics were given as prophylaxis. The main modality in the treatment of HIE is therapeutic hypothermia and this was carried out for 72 hours. The mother was advised to get family counseling and orogastric tube feeding training. The neonate as well as the mother was monitored closely for any signs of distress.

#### DISCUSSION

Hypoxic-Ischemic Encephalopathy is caused due to the inadequate supply of blood to the brain tissues that developed during labor or pregnancy. The baby was delivered flat, apneic, cyanosed, and with no heartbeat due to severe fetal distress because of antepartum hemorrhage. On Cardio Pulmonary Resuscitation, the heart rate was recovered back to above 100. On further investigations, the patient was diagnosed with severe HIE and the appropriate treatment was initiated. Therapeutic Hypothermia which is the only treatment available for HIE was initiated along with other treatment regimens including antiepileptics and

prophylactic antibiotics. The patient was then under round-the-clock observation for any kind of distress.

#### CONCLUSION

Hypoxic Ischemic Encephalopathy in the perinatal period is the major cause of neonatal death and disabilities. Therapeutic hypothermia is the only effective treatment for neonatal HIE at present. Several other treatment modalities are being tested but at present hypothermia is the only treatment modality that is used for HIE.

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