Salvaging New Lives: Low Birth Weight and NICU Protocol

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***Abstract*- Background :** A low birth weight baby is a clinical and diagnostic challenge. The neonatologists are faced with numerous neonatal intensive care unit protocols. This study was designed to review the policies of management of neonatal jaundice, sepsis, anemia, hypoglycemia, jaundice and hypoxic encephalopathy in a low birth weight newborn.

Methods: Care of newborns in was done in intensive care unit after numerous research papers on low birth weight management were referred.

Conclusion: The low birth weight newborn baby should be intubated electively if signs of respiratory distress appear. There should be an early Doppler of cerebral arteries to predict the ischemic changes in neonatal brain. Probiotic therapy with *Bifidobacterium bifidus* and *Streptococcus thermophillus* protects against necrotizing enterocollitis and results in increased weight gain. Newborn intravenous lines should not be flushed with normal saline ampoules containing benzyl alcohol as preservative as this increases the fluidity of neonatal blood brain barrier and predisposes to neonatal jaundice. Erythropoietin subcutaneous injections are most rewarding in low birth weight babies with neonatal anemia. There is also increased weight gain. Kangaroo care is useful in management of neonatal hypothermia and is also an immunological boast as the baby gets colonized with favorable microorganisms of maternal skin

***Index Terms*-** Low birth weight, Intubation, Neonatal intensive care unit, Jaundice, Hypothermia, Enterocollitis, Anaemia,

I. Introduction

Low birth weight may be the outcome of either preterm delivery (before 37 weeks of gestation) or retarded fetal (intrauterine) growth (1). The problems of the intrauterine growth retarded baby problems are due to uteroplacental insufficiency and inadequate substrata transfer leading to birth asphyxia, hypothermia, meconium aspiration, polycythemia, hypoglycemia, hypocalcaemia, thrombocythemia. On the other hand, the preterm complications are caused by anatomic and physiological immaturity. There is respiratory distress due to delayed alveolar clearance of alveolar fluid and surfactant deficiency. Postnatal circulatory adaptation is delayed due to pulmonary hypertension, systemic hypotension and delayed closure of the three fetal shunts (ductus venosus, ductus arteriosus and foramen ovale). Liver immaturity and reduced substrate explain the high prevalence of jaundice and deficiency of coagulation factors. Immature vascular development in retina and central nervous system predisposes to retinopathy and intraventricular hemorrhage. Immature skin and mucosa barrier and immature cellular and humoral immunity predisposes to neonatal sepsis and nosocomial infections. Gastrointestinal mucosa is immunological immature. Besides there is inappropriate bacterial gut colonization, this results in necrotizing enterocolitis.

A growth restricted preterm baby is a clinical and diagnostic challenge because dual problems of retardation and prematurity are superimposed.

The proportion of low birth weight has increased in the past twenty years. This increase is attributed to changes in the frequency of multiple births, increase in obstetrical interventions, and improved ascertainment of early preterm births and increased use of ultrasound for estimation of gestational age. Unfortunately the documentation of low birth weight babies is not proper (2).

There have been considerable advances in neonatal care. However, low birth weight babies have an altogether altered developmental, metabolic, nutritional status. Routine NICU protocols have to be modified to these babies with special needs (3-8).

This study was designed to study the various protocols and develop a strategy best suited for low birth weight newborns delivered in our institute.

II. Low Birth Weight Problems

The risk to a low birth weight newborn baby can be classified as:

1) Early risk: In the delivery room and neonatal life. The nursery neurobiological events of a low birth weight baby are incidence of neonatal septicemia, low blood pH, seizures, intraventricular leukomalacia and hypoglycemia. These factors correlate well with deficits in Bayley scale of infant development, mental developmental index and psychomotor development index (9). Relative importance of individual factors can be assessed as neurobiological risk score. This score correlates well with mental, motor, neurological outcomes (10).
2) Late risk: Long term developmental outcomes. The increased survival of low birth weight babies has resulted in an increased incidence of cerebral palsy. There are 2 postulated hypotheses (11). One theory is that as more low birth weight babies survive, they suffer the complications of extreme prematurity like periventricular leukomalacia, intraventricular hemorrhage, respiratory distress and sepsis resulting in postnatal brain damage in an otherwise normal infant.

Another hypothesis is that cerebral palsy and preterm birth have similar pathophysiology in antenatal period and that these babies who were compromised well before birth are now surviving.

Environmental enrichment programs are most effective in moderately low birth weight child who comes from a lower socio economic status (11).

III. CARE OF THE LOW BIRTH WEIGHT BABIES

Appropriate resuscitation/ respiratory care

Perinatal asphyxia is recognized as a major cause of neonatal morbidity and mortality in the developing countries. The effects are more pronounced among low birth weight babies. Delivery room policies have changed extremely. Until 1994, the low birth weight infants were intubated immediately after delivery, when presenting the slightest signs of respiratory distress or asphyxia. Later the guidelines were to do the continuous (15-20 seconds) pressure control (20-25cm H2O) inflation of the lungs using a nasal pharyngeal tube, followed by continuous positive airway pressure (4 to 6 cm H_2O) applied to all extremely low birth weight immediately after delivery to establish a functional residual capacity and perhaps to avoid elective intubation and mechanical ventilation (12). Literature search suggested no difference in the initial ventilator settings, ventilator days. The mortality and morbidity rates were found similar in extremely low birth weight babies with primary endotracheal intubation and mechanical ventilation in the delivery room as compared to infants with secondary endotracheal intubation and mechanical ventilation attributed to respiratory distress syndrome later in the intensive care unit. Extremely low birth weight babies which did not require endotracheal intubation and mechanical ventilation had no increased incidence bronchopulmonary dysplasia or periventricular leukomalacia and intraventricular hemorrhage.

It was inferred that individualized intubation strategy is safe as compared to routine immediate intubation of all extremely low birth weight babies.

Figure 1: A preterm low birth weight baby on phototherapy.

Neonatal hypoglycemia and Feeding

In low birth weight babies there is reduced reserve. Besides, increased utilization during birth hypoxia results in neonatal hypoglycemia. This is defined as a serum glucose level <30mg/100mg in the first few hours of birth.The highest incidence of hypoglycemia (67%) occurred in preterm low birth weight. It was 25% in term low birth weight babies and 18% in post term low birth weight babies (13)

Early initiation and frequent (2 to 3 hourly) feeding with breast milk is the most cost effective strategy in the prevention of hypoglycemia. Breast milk promotes ketogenesis and has a lower insulogenic effect (14, 15). Alternative feeds can be utilized in maternal HIV infection. In preterm neonates fortification of breast milk is essential. Micronutrients supplementation with vitamins and minerals promote better assimilation and weight gain. Total parenteral nutrition can be continued till 100ml/kg/day, is supplied by the entral route. The amount of feeding is increased slowly and stopped if any signs of feeding intolerance (vomiting, abdominal distension and increased gastric residual volume) appear.

Prevention of Necrotising Enterocolitis

At birth the basic body tries to develop an intricate symbiotic equilibrium between bacterial environment and its own immune system-an equilibrium that results in the preferential colonization of the gastrointestinal tract by a variety of "favorable" gram positive microorganisms most notably *Lactobaccillus* and *Bifidobacterium.*

In contrast the low birth weight new born intestine tends to be colonized by coliforms, enterococci and bacteroids. *Bifidobactium* and *Lactobaccillus* are found in the stools of <5% extremely low birth infants within the first month of life (16).

Probiotics strengthens the intestinal mucosal barrier which impedes the translocation of pathogenic bacilli in IL-10 knocked out mice. It was postulated that probiotics decrease cytokine production both systemically and at mucosal surface (17).

The pathogenesis of necrotizing enterocolitis is multi factorial. Prematurity, formula feeding, intestinal ischemia and bacterial colonization activate an inflammatory cascade accumulating in bowel necrosis. We speculated to create fresh suspension (0.5 teaspoon) of probiotic powder (ABC Dophilus) diluted in 3ml of mother's milk daily along with regular feeds. This provides 1.05 X 10^9 colony forming units/day, consisting of 0.35 X 10^9 CFU *Bifidabacterium infantis* ,0.35 X 10^9 CFU *Streptoccocus thermophilus* and 0.35 X 10^9 of *Bifidabacterium bifidus* .We add *S. thermophilus* as studies suggested the prevention of secondary rotavirus diarrhea when *S. thermophilus* was added (19). We decided not to include Lactobacillus, as cases of lactobacillus bacteremia have been described in immune compromised babies receiving high doses of lactobacillus (20)

Prevention of Hypothermia

Conductive and evaporative heat loss can be prevented by warming of delivery rooms, immediate drying and wrapping after birth, frequent feeding, delayed bathing and kangaroo mother care. Kangaroo mother care provides additional benefits as lowered incidence of nosocomial infections, as the babies skin gets colonized with friendly maternal skin microbes .There are other advantages as well. There is less incidence of lower respiratory tract disease, promotion of exclusive breast feeding

and better weight gain (21). Incubators, semi permeable plastic sheets and baby closure are other useful methods to prevent hypothermia.

Infection control

Neonatal infection contributes to 8-80% of all neonatal deaths (21). Approaches that have been used to prevent infection among low birth weight babies include strict policy of clean hands and avoiding overcrowding. Colonizing babies with maternal organisms via kangaroo mother care improves immunological maturation. This also leads to a favorable bacterial colonization (22). Keeping the nursery equipment clean and on regular bacterial colony surveillance prevents nosocomial infections. Preparing fresh feeds and hygienic dedicated nursing staff prevents incidence of sepsis. Parents' education and visitors policy is also carried out.

Neonatal Anemia

Anemia of prematurity is usually caused by inadequate erythropoitien production. In addition diagnostic tests cause blood loss.

We encourage delayed cord clamping in low birth weight babies. The corrected reticulocyte count is calculated by normalizing to a haemotocrit of 45 percent by multiplying the count by the actual haematocrit and dividing by 45.

Oral iron supplementation (2mg/kg) is started on Day 14 in all infants. If the serum ferritin fell below 100ng/ml or clinical signs of iron deficiency appear, the dose of iron is increased and 250 IU of epoetin beta per kilogram are given three times a week, subcutaneously after D3 of life till D42. Infants who were on ventilator or who were less than two weeks old with signs of anemia were transfused if their haematocrit fell below 40% or their hemoglobin concentration fell below 14gm per deciliter. If blood samples of totaling 9ml/kg had been obtained since previous transfusion, a repeat transfusion was considered. In spontaneously breathing babies older than two weeks, if fraction of inspired oxygen was less than 0.40, transfusion was given if they had clinical signs of anemia or their haematocrit was less than 32% and hemoglobin less than 11gm/dl. The heart rate and respiratory rate, blood pressure, blood gas values and renal and liver functions are monitored. In our NICU, blood sampling is done on day3, day12, day24, day40. The low birth weight boy babies, whose birth weight is more than 1200gms and whose baseline haematocrit is more than forty eight percent respond maximum to epoetin beta (23).

Intraventricular Hemorrhage and Retinopathy.

The cranial ultrasound scans are done on day3 and day12 to detect intraventricular hemorrhage. The regional cerebral blood flow study with power and pulsed Doppler is recommended, to detect impaired cerebrovascular autoregulation, if hypoxic ischaemic injury in extremely low birth weight neonates is suspected. Measuring the resistivity index in lenticulostriate arteries, in first week of life, can identify preterm neonates who are at risk of developing periventricular leukomalacia or germinal matrix hemorrhage or both (24).

Opthalmoscopy is done twice weekly, till 4 weeks after the estimated date of delivery, to detect retinopathy of prematurity at the earliest.

Hyperbilirubinemia

The hyperbilirubinemia in preterm infants is because of red cell, hepatic and gastrointestinal immaturity. After delivery, the postnatal hepatic bilirubin uptake and conjugation is slow. In preterm babies the delayed feeding limits intestinal flow and colonization (25). This results in increased bilirubin in enterohepatic circulation.

There should be no flushing of intravenous catheter with bacteriostatic saline ampules containing benzyl alcohol. Benzyl alcohol increases membrane fluidity and may facilitate the passage of bilirubin into the brain (26) Aggressive phototherapy and exchange transfusions if total serum bilirubin is 20mg/dl is recommended. It is unlikely that hyperbilirubinemia has a causal relationship with periventricular leucomalacia. Periventricular leucomalacia is primarily an ischaemic lesion, probably caused by hypoperfusion. Bilirubin is primarily toxic to neurons and not to glial elements which predominate in the periventricular white matter (25).

IV. Conclusion

Neonatologists are in a clinical quandary with respect to NICU protocols. This study was designed to compare various articles on aggressive and conservative management strategies for low birth weight babies. We have developed the indications for clinical interventions. By articulating the various research publications in terms of peculiar metabolic and developmental requirements of low birth weight babies, a protocol has been developed. Standardization of clinical methods and educating the paramedical staff is important for the success of any medical intervention. Training of mid-level health personnel on appropriate care of the low birth weight and providing management protocols/algorithms is of great importance. Record keeping for care audit and ongoing research is important.

V. Competing interests

We do not have any commercial association that might pose a conflict of interest in connection with the manuscript. We certify that neither this manuscript nor one with substantially similar content under our authorship has been published or is being considered for publication elsewhere.

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