



Rate of Decline in Total Serum Bilirubin with Double Surface Intensive Phototherapy and Fluid Supplementation in Severe Unconjugated Neonatal Hyperbilirubinemia

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Abstract

Background: Jaundice is the most common cause of readmission after discharge from birth hospitalisation. Among the adjunctive measures to compliment the effect of phototherapy, fluid supplementation has been proposed to reduce Sr. bilirubin levels. The current study aimed at assessing the effectiveness of intensive phototherapy in lowering the level of Serum bilirubin in neonates and reducing the need for exchange transfusion and duration of phototherapy.

Methodology: The prospective study was done at Parwati Clinic and Research Centre, Deoghar, Jharkhand. Total duration was of one year (from 1st April 2020 to 30th December 2020).

Babies of gestation age > 35 weeks who had severe hyperbilirubinemia in exchange transfusion zone. After selecting appropriate patients they were shifted to NICU and started on double surface intensive diode phototherapy. From above 4 LED phototherapy (make – lullaby) with average intensity of 60 μ W/cm²/nm. Babies were full tube fed with 30% extra fluid given over first 6 hours.

Results: There was a gross decline of in TSB 29.2 % at 6 hours and 45.38 % decline at 16.38 mg/dl. Exchange transfusion was not needed in any patient.

Conclusion: The present study, though observational, has shown an even more significant decline in TSB levels and greater reduction in ET rate (no exchange transfusion).

Keywords: Bilirubin, Phototherapy, Fluid Supplementation, Neonate, Hyperbilirubinemia

1. Introduction

Neonatal jaundice is the most common morbidity in the first week of life, occurring in 60% of term and 80% of preterm newborn [1]. Jaundice is the most common cause of readmission after discharge from birth hospitalization.

Neonatal jaundice is present in most newborns and is usually benign, it is imperative to carefully monitor newborns to identify those at developing bilirubin induced neurological dysfunction. Severe hyperbilirubinemia (defined as Serum Total Bilirubin level > 20 mg/dl) can develop signs of acute bilirubin

encephalopathy (ABE). If not treated immediately, Kernicterus might develop, a chronic neurologically devastating condition resulting from bilirubin toxicity in which brain stem nuclei and basal ganglia are damaged [2].

- Early clinical estimation by Kramer's staging can help in diagnosis but transcutaneous bilirubinometry is a better tool to screen, however, TSB must be confirmed by lab methods.
- High risk cases should be identified by looking for ABO mismatch, RH incompatibility, G6PD deficiency, Asphyxia, Acidosis, Sepsis and low gestation.
- Phototherapy has been the therapy of choice for the newborn with indirect hyperbilirubinemia. Intensive phototherapy requires a spectral irradiance of 30 micro/cm²/nm or higher, usually in the range of 430- 490 nm band, delivered over as much of the body surface area as possible and is nowadays recommended in the cases of neonatal hyperbilirubinemia with elevated total serum bilirubin (TSB) levels, as per the guidelines, i.e., if TSB rises rapidly (>0.5 mg/dl/hr). TSB is within 3 mg/dl of the threshold for Exchange transfusion and/or TSB fails to respond to single surface PT within 6 hours. Most promising results are with special blue fluorescent tubes or light emitting diode (LED), delivering output in blue green zone, have less heat output so less likely to cause insensible water loss. Maximizing the surface area of exposure by decreasing distance of phototherapy, minimizing clothes, double surface phototherapy, increasing reflectance by putting silver foil over walls has promising results[3].
- Among the adjunctive measures to compliment the effect of phototherapy, fluid supplementation has been proposed to reduce Sr. bilirubin levels. Poor caloric intake and/or dehydration associated with inadequate breastfeeding may contribute to the development of hyperbilirubinemia. Full enteral nutrition and extra fluid supplementation should lead to decrease entero-hepatic circulation and dehydration correction helping in rapid

decline of TSB. Maintaining adequate hydration and urine output during phototherapy is important since urinary excretion of lumirubin is the principal mechanism by which phototherapy reduces total bilirubin.

The current study aimed at assessing the effectiveness of intensive phototherapy in lowering the level of Serum bilirubin in neonates and reducing the need for exchange transfusion & duration of phototherapy.

2. Methodology

The prospective study was done at Parwati Clinic and Research Centre, Deoghar, Jharkhand. All babies are outborn from Jharkhand and nearby states. Total duration was one year (from 1st April 2020 to 30th December 2020).

Babies of gestation age > 35 weeks who had severe hyperbilirubinemia in exchange transfusion zone in accordance with recommendation of American Academy of paediatrics 2004 at that day of life were included in this study. Soon after admission, proper history was taken about gestation, h/o previous sibling affected with jaundice, mother's blood group, h/o ABO & RH haemolytic disease. Weight was taken with electronic weighing machine at emergency and sent total serum bilirubin, direct and indirect fraction, direct coombs test, G6PD, Hemoglobin level was taken in the same hospital with fully equipped laboratory facility. After that baby was shifted to NICU.

Gestation assessment was done by taking clinical history, last menstrual period & expected date of delivery & modified Ballard score chart if baby presented early. Weight was taken by electronic weighing machine. For TSB, we used AAP 2004 chart.

Babies only on clinical examination with following signs were excluded: Babies with signs of acute bilirubin encephalopathy at admission, such as:

- Stage-1: poor suck, stupor, hypotonia, seizure
- Stage 2: later hypertonia of extensor muscles, opisthotonus, retrocollis, fever.
- Stage 3: after 1st week hypertonia.

Total number of cases was eighty (60), all cases were included over a period of one year. All babies were outborn.

2.1 Intervention 1

After admission to NICU, written consent was taken from parents or available guardian. After selecting appropriate patients they were shifted to NICU and started on double surface intensive diode phototherapy. From above 4 LED phototherapy (make – lullaby) with average intensity of $60\mu\text{W}/$

cm^2/nm (Figure 1).

Measured by fluxmeter and from below bilibed with inbuilt LED phototherapy (make – fenem) with average intensity of $50\mu\text{W}/\text{cm}^2/\text{nm}$. Babies were kept naked except eyes covered.

To maximise intensity, phototherapy was kept as close as possible. Silver foils were applied to all four walls as shown in Figure 2. Intensity was measured with fluxmeter supplied with bilibed.



Figure 1: Intervention: Double Sureface Intensive Phototherapy

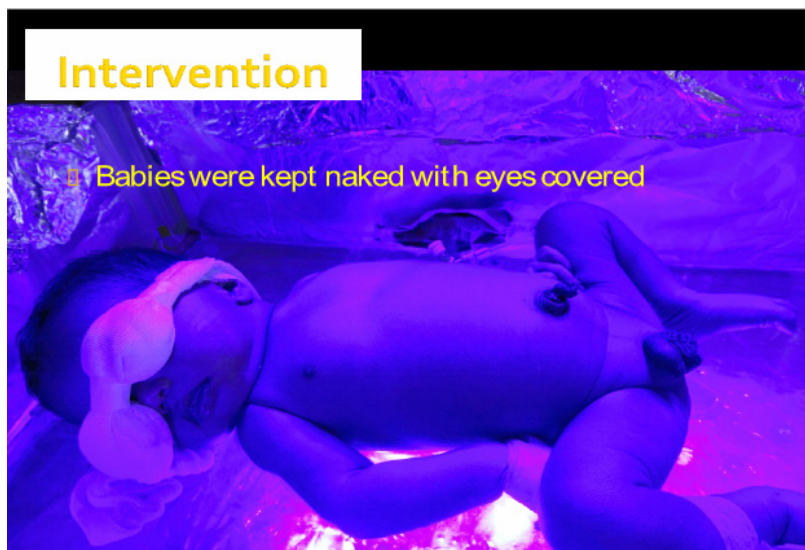


Figure 2: Intervention: Babies kept naked for phototherapy

2.2 Intervention 2

Extra fluid: Babies were full tube fed with 30% extra fluid given over first 6 hours. For instance, a 3 kg baby on day 5 – requirement will be 140 ml / kg/day, so given 35 ml every 2 hours with 30 % extra fluid – 125 ml (140 ml/kg x 0.3 = 125 ml).

2.3 Study Protocol/ Follow up

- Babies came with severe neonatal jaundice with total serum bilirubin in exchange zone according to AAP 2004 guideline.
- Double surface intensive diode phototherapy started with 30% extra fluid given intravenously with full tube feeding
- TSB repeated after 6 hrs, If still >5mg/dl above exchange zone cut-off, Exchange transfusion

was done

- If in the ET zone, but within 5 mg above the cut-off, and rate of decline was >1mg/dl/hr; intensive phototherapy was continued ,TSB was repeated after 12 hours, if still in exchange zone, ET was done (Figure 3).

2.4 Etiology

Major etiology found out of 60 cases was as follows (Figure 4).

1. ABO Mismatch- 16
2. G6PD Deficiency-10
3. RH Incompatibility-11
4. Idiopathic-18
5. Minor Blood GR Incompatibility-4
6. Both RH Incompatibility + G6PD DEF – 1

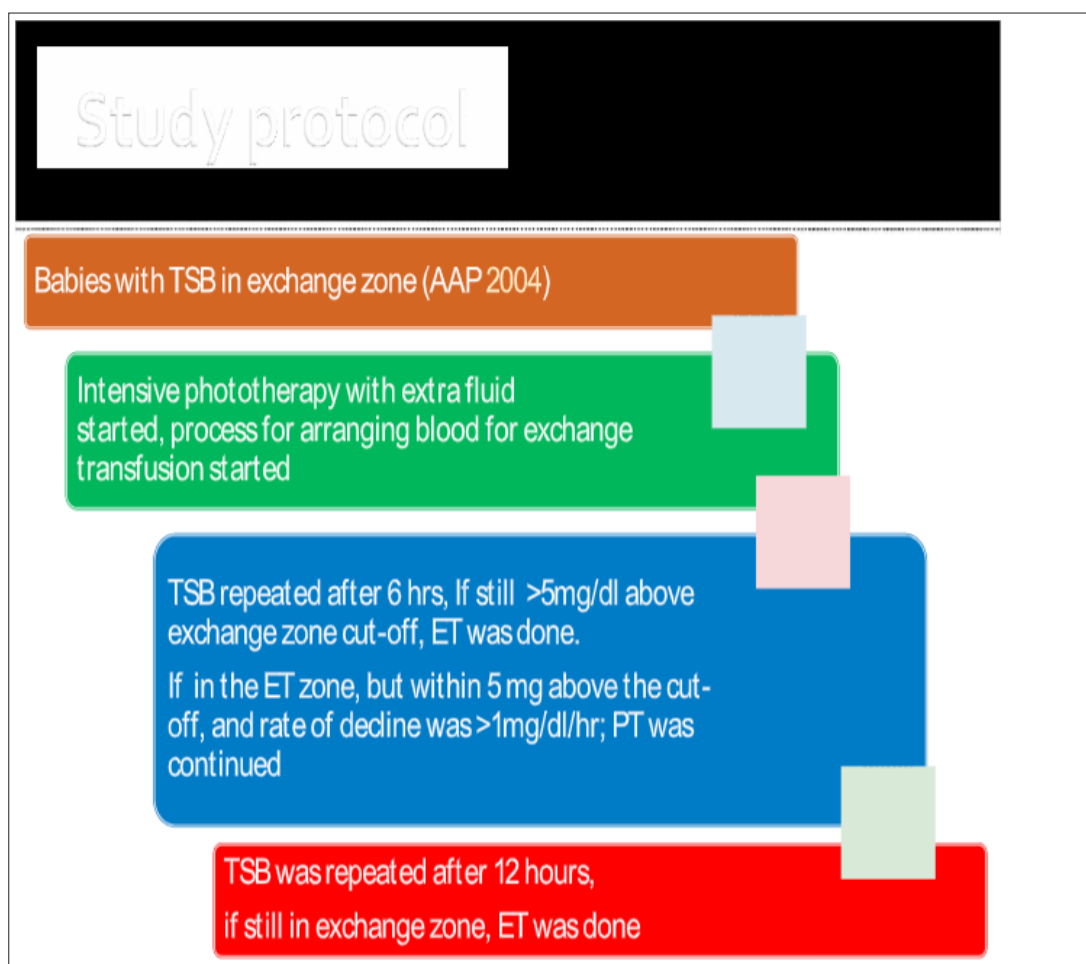


Figure 3: Study protocol

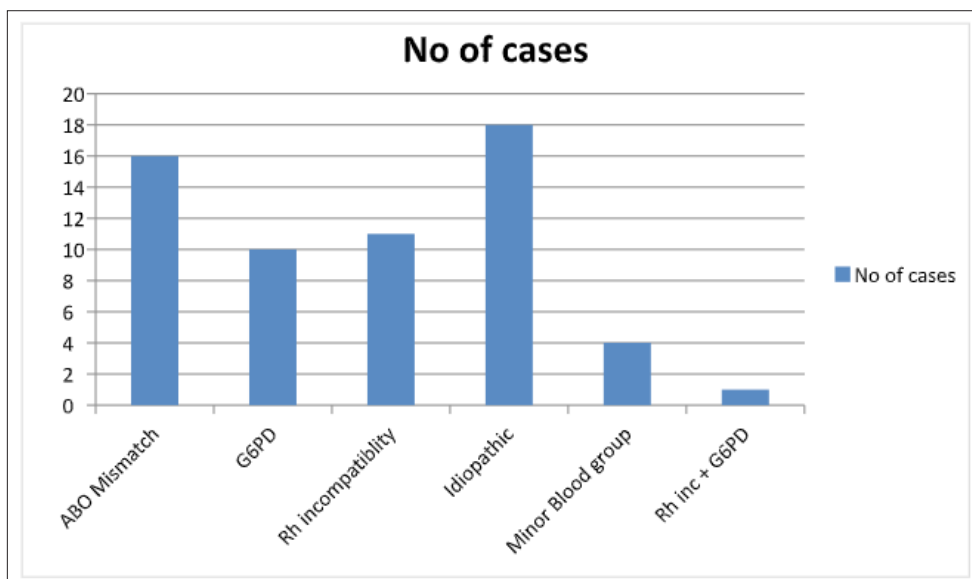


Figure 4: Major Etiology in 60 Neonates

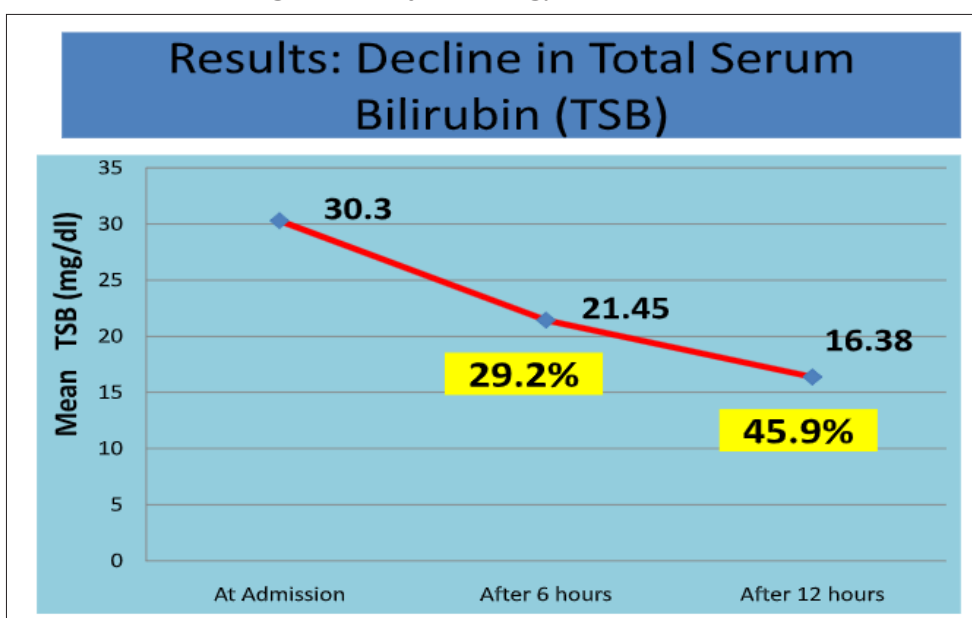


Figure 5: Decline in TSB over 6 & 12 hours

3. Results and Discussion

1. The mean rate of decline in total serum bilirubin 1.47 mg/dl/hour. Therefore, many exchange transfusion could be avoided by intensive diode phototherapy with extra fluid supplementation.
2. There was steady decline of 29.2 % in TSB over 6 hours and at the end of 12 hours there is decline of 45.9 % (Figure 5).
3. So, this shows that the intervention was more effective than exchange transfusion as far as rebound elevation in TSB is concerned (TSB can rise upto 60% of previous level after exchange transfusion).

4. Maximum number of patients was idiopathic followed by ABO mismatch.
5. Exchange transfusion was not needed in any patient.

A study conducted by Mehta et al. in 2005 to evaluate the effectiveness of fluid supplementation in decreasing the rate of exchange transfusion and the duration of phototherapy in term neonates with severe hyperbilirubinemia concluded that fluid supplementation in term neonates presenting with severe hyperbilirubinemia decrease the rate of exchange transfusion and duration of phototherapy [4].

Another prospective study was conducted at Cairo hospital: Egypt from Feb to July 2012 by Edris et al in 2014 to assess the role of Intensive Phototherapy in decreasing the need of exchange transfusion in neonatal jaundice and comprised 360 newborns with indirect hyperbilirubinemia. The 183 subjects were treated with Bilisphere 360 (Bilisphere group) compared with 177 who had been treated with conventional phototherapy (control group). Both groups were subjected to complete clinical evaluation and laboratory investigations [5].

This study proved that Bilisphere 360 in the treatment of indirect pathological hyperbilirubinaemia is as effective as exchange transfusion in lowering Total Serum Bilirubin when its level is within 2-3 mg/dl (34-51 $\mu\text{mol/l}$) of the exchange level.

Similarly, the researchers in the present study also found out that double surface intensive phototherapy followed by fluid supplementation reduce TSB and diminish exchange transfusion need.

4. Limitations

However, compared to another Indian study which also showed a significant reduction in the rate of ET in extra fluid treated group, the present study has certain limitations [4]:

1. This is an prospective observation study, to see the real difference outcome there should be a RCT.
2. Assessment of bilirubin encephalopathy is done in this study was based only on clinical examination only. BERA was not done.
3. Only short-term outcome was assessed with this study.

5. Conclusion

Only few studies have been done so far on the role of extra fluid supplementation with intensive

phototherapy in declining the TSB level. One RCT done previously in India was in an era when LED phototherapy was not used, yet it showed a significant reduction in TSB level by this method. The present study, though observational, has shown an even more significant decline in TSB levels and greater reduction in ET rate (no exchange transfusion). A large follow up study is needed to assess the neuro-developmental and audiological outcome of such intervention before a definite recommendation can be made about such intervention.

Conflict of Interest: None

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