

RESEARCH ARTICLE

## **A retrospective study comparing exchange transfusion and double surface phototherapy for the therapy of neonatal jaundice**

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### **Abstract**

Newborns frequently suffer from neonatal jaundice, which frequently necessitates medical attention. Selecting between intensive phototherapy and exchange transfusion is essential for successful treatment and avoiding side effects like kernicterus. The safety and effectiveness of exchange transfusion and double-surface phototherapy in treating severe infant jaundice are compared in this study. Forty-five newborns with severe hyperbilirubinemia were the subject of a six-month retrospective analysis at Anugrah Narayan Magadh Medical College in Gaya, from January to June 2024. Two groups of patients were created: Group B (n=22) received exchange transfusions, while Group A (n=23) received double-surface phototherapy. The outcomes demonstrated that, in comparison to exchange transfusion, double-surface phototherapy successfully reduced bilirubin levels with fewer side effects. The outcomes demonstrated that, in comparison to exchange transfusion, double-surface phototherapy successfully reduced bilirubin levels with fewer side effects. Group B demonstrated a bilirubin reduction of  $9.1 \pm 2.3$  mg/dL ( $p=0.14$ ), whereas Group A exhibited a mean reduction of  $8.2 \pm 2.1$  mg/dL. Group A experienced considerably fewer complications (8.7%) than Group B (27.3%) ( $p<0.05$ ). According to the results, in some situations, double-surface phototherapy may be a safer and more efficient option for treating severe infant jaundice than exchange transfusion.

**Keywords:** Neonatal jaundice(NJ), Neonatal Intensive Care Unit (NICU), Phototherapy, Exchange transfusion (ET), Hyperbilirubinemia, Kernicterus

## **INTRODUCTION**

In the first week of life, about 60% of full-term and 80% of preterm infants suffer from neonatal jaundice [1]. Even though physiological jaundice is usually benign, pathological hyperbilirubinemia can cause serious side effects such kernicterus and acute bilirubin encephalopathy [2]. Exchange transfusion has always been the recommended course of treatment for severe instances, especially when phototherapy is unsuccessful or bilirubin levels hit critical thresholds [3].

Exchange transfusion does, however, come with a number of serious hazards, such as infection,

## **MATERIALS AND METHODS**

### **Study Design and Setting**

This retrospective observational research was conducted in the paediatric department of Anugrah Narayan Magadh Medical College and Hospital in Gaya, Bihar, India. The research procedure was approved by the Institutional Ethics Committee.

### **Study Period**

October 2024 to March 2025 (6 months)

### **Study Population**

During the research period, the medical histories of infants with severe hyperbilirubinemia who were hospitalised to the NICU were investigated.

### **Sample Size**

The research focused on the inclusion criteria and included 45 newborns in total.

### **Inclusion Criteria**

thrombocytopenia, electrolyte imbalances, and heart problems. New developments in phototherapy, especially double-surface phototherapy, present a possibly safer option [5]. To maximise exposure and improve bilirubin breakdown, this method makes use of light sources both above and below the baby [6,7]. In order to treat severe newborn jaundice in a tertiary care centre, this research evaluates the safety and effectiveness of exchange transfusion and double-surface phototherapy.

- Term babies (born at 37 weeks gestation)
- Age 24 hours to 7 days
- Total serum bilirubin levels warranting intensive treatment ( $>15$  mg/dL in term infants)
- Complete medical records available

### **Exclusion Criteria**

- Preterm babies ( $<37$  weeks)
- Neonates with major congenital anomalies
- Evidence of hemolytic disease requiring immediate exchange transfusion
- Incomplete medical records
- Signs of acute bilirubin encephalopathy at admission

### **Groups**

- Group A (Double Surface Phototherapy):  $n=23$

- Group B (Exchange Transfusion): n=22

## Intervention Protocols

### Double Surface Phototherapy (Group A)

- LED phototherapy units positioned above and below the infant
- Wavelength: 450-470 nm
- Light intensity: 30-40  $\mu\text{W}/\text{cm}^2/\text{nm}$
- Continuous therapy with breaks only for feeding and care
- Duration: Until bilirubin levels dropped below 12 mg/dL

### Exchange Transfusion (Group B)

- Transfusion with double volume exchange (160 mL/kg)
- Fresh whole blood or reconstituted blood used
- Procedure performed via umbilical venous catheter
- Standard monitoring protocols followed

## Outcome Measures

### Primary Outcomes

- Rate of bilirubin reduction (mg/dL/hour)
- Time to achieve target bilirubin levels (<12 mg/dL)

- Treatment success rate

## Secondary Outcomes

- Complications during treatment
- Length of hospital stay
- Need for additional interventions
- Neurological outcomes at discharge

## Data Collection

Information was extracted from medical records, such as:

- Demographic attributes
- Experimental presentation
- Laboratory parameters
- Treatment details
- Complications
- Outcomes

## Statistical Analysis

Analysis was conducted using SPSS version 26.0. Independent t-tests were used to compare continuous variables (mean  $\pm$  standard deviation), while chi-square tests were used to analyse categorical data. P-values less than 0.05 were regarded as statistically significant.

## RESULTS

Table no.1: Demographical Characteristics

Parameter	Group A (n=23)	Group B (n=22)	p-value
Mean gestational age (weeks)	38.2 ± 1.1	38.5 ± 1.3	0.39
Mean birth weight (kg)	2.85 ± 0.32	2.91 ± 0.28	0.47
Male gender (%)	65.2	59.1	0.66
Mean age at admission (hours)	72.3 ± 18.4	68.7 ± 21.2	0.52

Table no.2: Clinical Presentation

Parameter	Group A	Group B	p-value
Mean initial bilirubin (mg/dL)	18.7 ± 2.3	19.2 ± 2.1	0.43
Lethargy (%)	43.5	45.5	0.89
Poor feeding (%)	52.2	50.0	0.87
Irritability (%)	26.1	31.8	0.65

Treatment Outcomes

- p-value: 0.09

Bilirubin Reduction

Time to Target Bilirubin (<12 mg/dL)

- Group A: Mean reduction of 8.2 ± 2.1 mg/dL over 48 hours
- Group B: Mean reduction of 9.1 ± 2.3 mg/dL over 48 hours
- p-value: 0.14 (not statistically significant)
- Group A: 52.3 ± 12.8 hours
- Group B: 46.7 ± 11.2 hours
- p-value: 0.12

Rate of Bilirubin Decline

Treatment Success Rate

- Group A: 0.18 ± 0.04 mg/dL/hour
- Group B: 0.21 ± 0.05 mg/dL/hour
- Group A: 91.3% (21/23)
- Group B: 95.5% (21/22)
- p-value: 0.61

Table no.3: Complications

Complication	Group A (n=23)	Group B (n=22)	p-value
Total complications	2 (8.7%)	6 (27.3%)	0.04*
Hypocalcemia	1 (4.3%)	3 (13.6%)	0.33
Thrombocytopenia	0 (0%)	2 (9.1%)	0.23
Infection	0 (0%)	1 (4.5%)	0.49
Hypothermia	1 (4.3%)	0 (0%)	0.51

\*Statistically significant

Hospital Stay

- **Group A:** Mean duration 4.2 ± 1.3 days
- **Group B:** Mean duration 5.1 ± 1.8 days
- **p-value:** 0.045 (statistically significant)

Neurological Outcomes

Neither group experienced acute bilirubin encephalopathy or kernicterus during the research period.

DISCUSSION

Double surface phototherapy is a successful substitute for exchange transfusion in the treatment of severe infant jaundice, as this retrospective research shows [6]. Although the progression of bilirubin decrease was somewhat faster with exchange transfusion, the variation was not statistically significant, indicating similar therapeutic efficacy.

The phototherapy group's far reduced morbidity rate (8.7% vs. 27.3%, p<0.05) accentuates the non-invasive method's safety benefit [7]. Due to its intrusive nature, exchange transfusions are

susceptible to infection, coagulation problems, and electrolyte imbalances[8]. Our results are consistent with other research that found exchange transfusion complications range from 12 to 24 percent [9,10].

The phototherapy group's shorter hospital stay (4.2 vs. 5.1 days, p<0.05) raises the possibility of financial gains and less strain on medical resources.. This finding is consistent with other studies comparing intensive phototherapy with exchange transfusion [10,11].

Several factors may influence the choice between these treatment modalities [12]:

1. **Severity of hyperbilirubinemia:** Exchange transfusion may still be preferred for extremely high bilirubin levels or when rapid reduction is crucial.
2. **Underlying etiology:** Hemolytic causes may respond better to exchange transfusion due to removal of circulating antibodies.
3. **Clinical condition:** Sick neonates may not tolerate the stress of exchange transfusion.

**Resource availability:** Double surface phototherapy requires specialized equipment but fewer personnel compared to exchange transfusion [13].

## CONCLUSION

Double surface phototherapy lowers blood bilirubin levels with a potency comparable to exchange transfusions, providing improved safety characteristics and a shorter hospital stay. This non-invasive technique could be a helpful alternative in some cases for treating severe baby jaundice, which would reduce the requirement for exchange transfusions and the associated complications.

More realistic standardised controlled trials with bigger sample numbers and long-term follow-up are required to evaluate neurodevelopmental outcomes and provide unquestionable therapeutic recommendations.

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## LIMITATION

1. Retrospective design with inherent selection bias
2. Small sample size limiting generalizability
3. Short follow-up period
4. Single-center study
5. Lack of long-term neurodevelopmental outcomes

## CLINICAL IMPLICATIONS

Our findings suggest that double surface phototherapy can be considered as first-line therapy for severe neonatal jaundice in stable term infants, potentially reducing the requirement for exchange transfusion [14]. However, exchange transfusion remains essential for cases with extremely high bilirubin levels or clinical signs of acute bilirubin encephalopathy [15].

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## CONFLICT OF INTEREST

No conflicts of interest are disclosed by the writers.

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