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Evaluation of Treatment Outcomes of Neonatal Phototherapy for Neonatal Unconjugated Hyperbilirubinemia at the Pediatrics Department of Khanh Hoa Hospital

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Abstract: *Neonatal unconjugated hyperbilirubinemia is a common condition which, if left untreated, may lead to severe complications such as kernicterus, irreversible neurological damage, or death. Despite being frequent, jaundice remains a leading cause of neonatal readmission, especially in developing countries. Phototherapy is the standard, safe, and effective treatment that significantly reduces serum bilirubin levels and minimizes the need for exchange transfusion. This study aims to evaluate the treatment outcomes of phototherapy in neonates with unconjugated hyperbilirubinemia at the Pediatrics Department of Khanh Hoa Hospital.* ***Subjects and methods:*** *All inpatients diagnosed with neonatal unconjugated hyperbilirubinemia and indicated for phototherapy at the Pediatrics Department of Khanh Hoa Hospital from October 2023 to April 2024 were included in the study.* ***Result****: The male-to-female ratio was 1,18:1. Preterm infants accounted for 57.5% of the cases. Jaundice appeared predominantly after 72 hours of birth. Among the jaundiced infants, 55.2% had concurrent infections. Hemolytic jaundice due to maternal-fetal blood group incompatibility accounted for 3.4%. In this group, the mean serum bilirubin level at admission was 345.7 ± 55.4 µmol/L, and the average duration of phototherapy was longer compared to those without blood group incompatibility. The majority of infants recovered (98.8%), with only one case (1.2%) requiring exchange transfusion. The rate of bilirubin reduction after 72 hours of phototherapy was faster in infants without blood group incompatibility, full-term infants, those with normal birth weight, and those without concurrent infections, compared to those with blood group incompatibility, low birth weight, preterm birth, or associated infections. Similarly, the average duration of phototherapy was shorter in infants without blood group incompatibility, full-term, normal weight, and non-infected infants compared to their respective counterparts. The mean phototherapy duration using double-sided fluorescent lights was 3.9 ± 1.05 days, significantly shorter than that of single-sided fluorescent lights (5.88 ± 1.84 days).* ***Conclusion:*** *Neonates with jaundice requiring phototherapy and concurrent medical conditions had higher bilirubin levels compared to those without comorbidities, highlighting the importance of early hospital admission or clinical evaluation when jaundice is accompanied by other illnesses. Although the incidence of jaundice due to blood group incompatibility was low (3 out of 87 cases), one case required exchange transfusion. Therefore, it is essential to provide professional training on exchange transfusion techniques for healthcare units performing phototherapy in order to minimize the need for referrals and ensure timely treatment for affected infants.*

Keywords: *Phototherapy, neonatal hyperbilirubinemia, newborn, Khanh Hoa Hospital.*

I. Introduction

Neonatal jaundice due to elevated unconjugated bilirubin is a common condition, occurring in approximately 60% of full-term and 80% of preterm infants during the first week after birth [5]. Most cases are physiological jaundice, but in certain situations, high bilirubin levels can cause irreversible brain damage [6]. Phototherapy is the first-line, safe, and effective treatment method that helps prevent severe neurological complications [6]. At Khanh Hoa Hospital, phototherapy is routinely applied for the treatment of neonatal jaundice. Therefore, to assess treatment efficacy and contribute to improving the quality of neonatal care, we conducted the study entitled: "Evaluation of Treatment Outcomes of Phototherapy for Neonatal Unconjugated Hyperbilirubinemia at the Pediatrics Department, Khanh Hoa Hospital".

II. Objectives

(1) To describe the clinical and paraclinical characteristics of neonatal unconjugated hyperbilirubinemia at the Pediatrics Department of Khanh Hoa Hospital
(2) To evaluate the treatment outcomes of phototherapy in neonatal unconjugated hyperbilirubinemia at the same department.

III. Research Methodology

A. Study design

A descriptive case series study.

B. Sample

Sampling method: A convenience sampling method was applied. Inclusion criteria: Neonates diagnosed with unconjugated hyperbilirubinemia who met the phototherapy treatment threshold according to AAP guidelines [5], and whose guardians provided informed consent to participate in the study. Exclusion criteria: Neonates with direct (conjugated) hyperbilirubinemia; those with immediate indications for exchange transfusion; those presenting with kernicterus upon admission; neonates who had already received phototherapy prior to admission; and those in critical

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condition due to comorbidities that precluded the initiation of phototherapy.

C. Data processing

Data were cleaned and processed using SPSS 25.0 software. Results are presented in table form with information on frequency, percentage, mean, OR and 95% CI.

D. Approval

The study was approved by the scientific council of Buon Ma Thuot University of Medical and Pharmacy and was accepted by the research subjects. The research subjects clearly explained before collecting information. In addition, we do not use this information for any other purpose.

IV. Result and Discussion

A. Clinical and Paraclinical Characteristics of the Study Population

TABLE I: Clinical and Paraclinical Characteristics of the Study Population

Content		Frequency (n)	Rate (%)
Sex	Male	47	54,0
	Female	40	46,0
Gestational Age (weeks)	≥ 37	37	42,5
	< 37	50	57,5
Admission Weight (grams)	≥ 2500	67	77,0
	< 2500	20	23,0
Age at Onset of Jaundice (hours)	< 24	0	0
	24 - 48	7	8,1
	49 - 72	9	10,3
	> 72	71	81,6
Severity of jaundice	Zone 1	0	0
	Zone 2	0	0
	Zone 3	1	1,2
	Zone 4	39	44,8
	Zone 5	47	54,0
Mother-Infant Blood Group Incompatibility	Yes	3	3,4
	No	84	96,6
Associated Infection	Yes	48	55,2
	No	39	44,8

The male-to-female ratio was 1,18:1. Jaundice mainly occurred in preterm infants (57,5%). Most infants were of normal birth weight (77%). The majority (81,6%) developed jaundice after 72 hours of life. This result is consistent with previous studies by Tran Thi Kieu Anh et al. (2022), Bui Khanh Linh (2018) and Dipak Kumar (2021) [1], [4], [7]. On admission, 98,8% had jaundice in Kramer zones 4 or 5. This finding aligns with the study by Phung Thi Huyen et al., which indicated that neonates older than 2 days mainly presented with more severe jaundice (Kramer zones 4–5), whereas those under 2 days primarily exhibited jaundice in Kramer zone 3 [2]. Blood group incompatibility was identified in 3 cases (3,4%). There is a difference compared to the studies by Tran Thi Kieu Anh and Dipak Kumar, which may be attributed to variations in testing indications, study populations, and research settings across different institutions [1]. Jaundice with associated infection accounted for 55,2%; 44,8% had isolated jaundice. The study results are similar to some studies [1], [4], [7].

B. Treatment outcomes of free bilirubin-induced jaundice using phototherapy

TABLE II: Treatment outcomes of free bilirubin-induced jaundice using phototherapy

Content		Frequency (n)	Rate (%)
Treatment results	Successfully treated	86	98,8
	Fatal outcome	1	1,2

Most cases were successfully treated (98.8%), with only one case requiring exchange transfusion (1.2%). The study results are similar to some studies [1], [2], [3].

C. Change in bilirubin levels during phototherapy

TABLE III: Change in bilirubin levels during phototherapy

Mean bilirubin level	Bilirubin level ± SD (µmol/L)
Baseline mean bilirubin level	297,8 ± 36,4
Mean bilirubin level after 72 hours	217,5 ± 51,5

At the start of phototherapy, the mean bilirubin level was 297.8 ± 36.4 µmol/L. After 72 hours of treatment, it decreased to 217.5 ± 51.5 µmol/L, with an average reduction of approximately 80 µmol/L. The study results are similar to some studies [3], [4].

D. Changes in serum unconjugated bilirubin levels before and after phototherapy

TABLE IV: Changes in serum unconjugated bilirubin levels before and after phototherapy

Content \ Bilirubin level		Before phototherapy	After 72 hours of phototherapy	P
Mother-Infant Blood Group Incompatibility	Yes	345,7 ± 55,4	311,6 ± 89,9	0,019
	No	296,1 ± 34,8	214,2 ± 47,1	
Gestational Age (weeks)	< 37	288,1 ± 33,3	210,3 ± 44,5	0,13
	≥ 37	310,9 ± 36,8	227,3 ± 59	
Admission Weight (grams)	< 2500	270,6 ± 31,3	200,2 ± 38,2	0,83
	≥ 2500	306,1 ± 34,2	223 ± 53,7	
Associated Infection	Yes	288,2 ± 33	206 ± 42	0,019
	No	309,5 ± 38,4	231,8 ± 58,7	

Infants with maternal-neonatal blood group incompatibility had significantly higher initial bilirubin levels and showed a slower reduction after 72 hours of phototherapy compared to those without incompatibility ($P < 0.05$). Term infants had higher initial bilirubin levels and slightly greater reduction compared to preterm infants, but the difference was not statistically significant ($P > 0.05$). Normal birth weight infants had higher baseline bilirubin and a greater reduction than low birth weight infants, with no statistically significant difference ($P > 0.05$). Infants with coexisting infections had lower initial bilirubin levels but experienced a faster reduction after phototherapy compared to those without infections. This difference was statistically significant ($P < 0.05$).

E. Correlation between selected clinical factors and the mean duration of phototherapy

There was no statistically significant difference in phototherapy duration between infants with jaundice in Kramer zones 4 and 5 ($P = 0.29$). Preterm infants, those with

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blood group incompatibility, concurrent infections, and those treated with single-sided fluorescent phototherapy had significantly longer treatment durations ($P < 0.05$). Infants with jaundice onset after 72 hours and those who were underweight also had longer phototherapy durations, but the differences were not statistically significant ($P > 0.05$).

TABLE IV: Correlation between selected clinical factors and the mean duration of phototherapy

Content		n	Mean duration of phototherapy (days)	P
Severity of jaundice	Zone 1	0	0	0,29
	Zone 2	0	0	
	Zone 3	1	0	
	Zone 4	39	5,15 ± 1,9	
	Zone 5	47	5,21 ± 1,8	
Gestational Age (weeks)	< 37	50	5,56 ± 2,13	0,037
	≥ 37	37	4,62 ± 1,4	
Mother-Infant Blood Group Incompatibility	Yes	3	6	0,01
	No	84	5,19 ± 1,89	
Age of jaundice onset (hours)	24-48	7	4,57 ± 1,51	0,5
	49-72	9	4,89 ± 1,36	
	> 72	71	5,32 ± 1,95	
Admission Weight (grams)	< 2500	20	5,85 ± 2,56	0,2
	≥ 2500	67	5,02 ± 1,58	
Associated Infection	Yes	48	5,65 ± 2,12	0,013
	No	39	4,69 ± 1,34	
Phototherapy light type	Single-sided fluorescent	58	5,88 ± 1,84	0,01
	Double-sided fluorescent	29	3,9 ± 1,05	

VI. Recommendations

Neonates with jaundice accompanied by other medical conditions tend to have higher bilirubin levels; therefore, early hospital admission or medical evaluation is recommended in such cases.

It is essential to provide professional training on exchange transfusion techniques at facilities that perform phototherapy, in order to reduce unnecessary transfers and ensure timely treatment for affected infants.

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