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Inpatient observation after phototherapy ≥35-week newborns: a retrospective study of bilirubin rebound

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ABSTRACT

Introduction: phototherapy (PT) is an effective treatment for neonatal hyperbilirubinemia; however, controversy persists regarding the need for in-hospital observation after discontinuation to detect possible "rebound." The aim was to evaluate the frequency with which hospitalization is prolonged solely for bilirubin monitoring after discontinuing PT and its usefulness in identifying clinically significant rebound.

Material and methods: a retrospective analytical cohort study was conducted in a tertiary hospital (2019–2022), including newborns ≥35 weeks admitted for hyperbilirubinemia and treated with PT. Two strategies after discontinuation of PT were compared: inpatient observation versus discharge with outpatient follow-up. The primary outcome was the detection of rebound, defined as the return of bilirubin to the phototherapy threshold within 72-96 hours.

Results: 155 infants were included; 60 (38.7%) remained hospitalized for monitoring and 95 (61.2%) were discharged with outpatient follow-up. Baseline characteristics, bilirubin levels, and duration of PT were similar between groups. The total hospital stay was longer in the observation group (mean 2.57 days) than in the immediate discharge group (1.75 days), but this difference was not statistically significant (p=0.053). The overall incidence of rebound was 3.2% (5/155): one case was detected during in-hospital observation and four during outpatient follow-up (48–72 hours). No adverse events were reported.

Conclusions: clinically significant rebound after phototherapy discontinuation was uncommon and rarely detected during immediate inpatient observation. In selected low-risk term newborns with reliable outpatient follow-up, routine prolongation of hospitalization for rebound monitoring may be unnecessary, whereas higher-risk infants may still require closer surveillance. These findings should be interpreted cautiously given the retrospective single-center design and the limited number of rebound events.

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Observación hospitalaria tras fototerapia en recién nacidos de ⩾35 semanas: un estudio retrospectivo del rebote de bilirrubina

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RESUMEN

Introducción: La fototerapia (FT) es un tratamiento eficaz para la hiperbilirrubinemia neonatal; sin embargo, persiste la controversia sobre la necesidad de observación hospitalaria tras su interrupción para detectar un posible efecto rebote. El objetivo fue evaluar la frecuencia con la que se prolonga la hospitalización únicamente para el control de la bilirrubina tras la interrupción de la FT y su utilidad para identificar un efecto rebote clínicamente significativo.
Material y métodos: Se realizó un estudio de cohorte analítico retrospectivo en un hospital de tercer nivel (2019-2022), que incluyó a recién nacidos ≥35 semanas ingresados por hiperbilirrubinemia y tratados con FT. Se compararon dos estrategias tras la interrupción de la FT: observación hospitalaria frente a alta con seguimiento ambulatorio. El resultado principal fue la detección del efecto rebote, definido como el retorno de la bilirrubina al umbral de fototerapia en un plazo de 72 a 96 horas.
Resultados: Se incluyeron 155 lactantes; 60 (38,7 %) permanecieron hospitalizados para monitorización y 95 (61,2 %) fueron dados de alta con seguimiento ambulatorio. Las características basales, los niveles de bilirrubina y la duración de la fototerapia fueron similares entre los grupos. La estancia hospitalaria total fue más prolongada en el grupo de observación (media de 2,57 días) que en el grupo de alta inmediata (1,75 días), pero esta diferencia no fue estadísticamente significativa (p=0,053). La incidencia global de rebote fue del 3,2% (5/155): se detectó un caso durante la observación hospitalaria y cuatro durante el seguimiento ambulatorio (48-72 horas). No se notificaron eventos adversos.
Conclusiones: el rebote clínicamente significativo tras la interrupción de la fototerapia fue infrecuente y rara vez se detectó durante la observación hospitalaria inmediata. En recién nacidos a término de bajo riesgo seleccionados con un seguimiento ambulatorio fiable, la prolongación rutinaria de la hospitalización para la monitorización del rebote podría ser innecesaria, mientras que los lactantes de mayor riesgo podrían requerir una vigilancia más estrecha. Estos hallazgos deben interpretarse con cautela debido al diseño retrospectivo de un solo centro y al número limitado de casos de rebote.

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1. INTRODUCTION

Hyperbilirubinemia is a leading cause of neonatal hospitalization. Management aims to prevent bilirubin-induced neurotoxicity while minimizing costs and avoiding unnecessary disruption of the mother–infant dyad [1–3]. Phototherapy (PT) is the standard treatment; however, guidelines vary regarding its initiation, discontinuation, and post-treatment monitoring [4–6].

Bilirubin rebound—defined as an increase in total serum bilirubin (TSB) requiring reinstitution of PT within 72–96 hours—is a relevant clinical concern after PT cessation. Rebound risk is associated with lower gestational age, earlier initiation of PT, and TSB levels close to the treatment threshold at discontinuation. These factors have been incorporated into prediction models, which perform well in derivation cohorts but show only modest accuracy in external validation studies [7–11].

Prolongation of hospitalization solely for rebound monitoring is not strongly supported by evidence and may negatively affect breastfeeding and mother–infant bonding. Current recommendations emphasize risk-stratified post-PT monitoring and timely outpatient follow-up [4, 6]. Spanish guidelines similarly highlight individualized risk assessment prior to discharge [5].

The aim of this study is to quantify the frequency of hospitalization prolonged exclusively for bilirubin monitoring after PT, describe the clinical characteristics of infants managed with this strategy, and assess its usefulness in detecting clinically significant rebound.

2. MATERIAL AND METHODS

2.1. STUDY DESIGN AND SETTING

Retrospective cohort study at the Department of Neonatology, tertiary public hospital, Madrid, Spain (Jan 2019–Dec 2022). Clinical management, including the initiation and discontinuation of phototherapy, followed Spanish Society of Neonatology [5] and AAP 2004 guidelines [12]. The timing of post-phototherapy bilirubin reassessment, as well as the decision regarding hospital discharge, was left to the discretion of the attending clinician.

2.2. STUDY POPULATION

Inclusion: newborns ≥35 weeks' gestation admitted for hyperbilirubinemia and treated with PT. Exclusion: <35 weeks, major congenital malformations, primary admissions for other conditions, or incomplete records. Isoimmune hemolysis was defined as a positive direct Coombs test or ABO/Rh incompatibility with consistent clinical/laboratory findings.

2.3. DATA COLLECTION

Data were collected from electronic health records and hospital registries. Maternal characteristics, gestational/delivery data, neonatal conditions, PT parameters, and readmissions were recorded.

2.4. VARIABLES AND DEFINITIONS

Primary outcome: detection of clinically significant bilirubin rebound during extended hospitalization. Rebound was defined as total serum bilirubin (TSB) returning to the phototherapy (PT) treatment threshold within 72 hours. PT initiation and discontinuation followed American Academy of Pediatrics and Spanish guidelines. Prespecified risk factors included gestational age <38 weeks, early initiation of PT, TSB levels near the treatment threshold at discontinuation, and hemolysis. Other variables included sex, birth weight, mode of delivery, feeding method, TSB at admission and at PT discontinuation, PT duration, total hospital stay, and readmission for hyperbilirubinemia.

2.5. SAMPLE SIZE AND STATISTICAL ANALYSIS

All consecutive eligible cases were included. Given the low incidence of rebound (~3–5%), the study is primarily descriptive, and subgroup analyses are limited in power. Continuous variables are mean (SD) or median [IQR]; categorical variables as n (%). Comparisons used t-test/Mann–Whitney or χ^2/Fisher as appropriate; $\alpha = 0.05$.

2.6. ETHICAL CONSIDERATIONS

Approved by the Research Ethics Committee of Hospital Fundación Alcorcón (protocol 22/112; Oct 18, 2022). Informed consent was waived due to use of routine data. Data were anonymized and processed according to Spanish and EU data protection laws.

3. RESULTS

During the study period, 155 newborns ≥35 weeks were admitted for hyperbilirubinemia and treated with PT. Sixty (38.7%) remained hospitalized for an additional bilirubin check, while 95 (61.2%) were discharged with outpatient follow-up.

3.1. BASELINE CHARACTERISTICS

Baseline neonatal and mate rnal characteristics are summarized in Table 1. No significant differences were observed in gestational age, birth weight, sex, mode of delivery, or presence of risk factors (late prematurity, excessive weight loss, hemolysis).

3.2. PHOTOTHERAPY AND HOSPITAL STAY

Age at PT initiation, TSB at admission and discontinuation, and PT duration were similar between groups (Table 2). Total length of stay was longer in the hospitalized group (mean 2.57 vs. 1.75 days; $p = 0.053$).

3.3. BILIRUBIN REBOUND

Seven patients were initially identified with suspected rebound hyperbilirubinemia; of these, two were excluded for not meeting the strict rebound criteria. Clinically significant rebound occurred in 5 infants (3.2%): 1 detected during hospitalization, 4 during outpatient follow-up at 48–72 hours. No acute bilirubin encephalopathy or complications occurred (Figure 1). The main characteristics of these patients are shown in Table 3.

Table 1: Summary of baseline characteristics of newborns admitted for jaundice	
Variable	**Value**
Gestational age (weeks), mean (SD)	38.2 (1.6)
Female sex, n (%)	80 (51.6)
Birth weight (g), mean (SD)	3128.6 (447.7)
Length (cm), mean (SD)	48.98 (1.98)
Head circumference (cm), mean (SD)	34.32 (1.41)
Maternal age (years), mean (SD)	34.2 (5)
Controlled pregnancy, n (%)	98
Vaginal delivery, n (%)	131 (85.6)
Risk factors for hyperbilirubinemia, n (%)	24 (15.4)
Isoimmunization, n (%)	5 (3.2)
Exclusive breastfeeding, n (%)	98 (64.9)
Total serum bilirubin at start of phototherapy (mg/dL), median [IQR]	17.45 [15.9–19.9]
Age at admission (hours), median [IQR]	60 [48–83.5]
Percentage weight loss at admission, median [IQR]	6.75 [5–8.4]
Phototherapy duration (hours), median [IQR]	24 [22–36]
Length of stay (days), median [IQR]	2 [1–3]
Total serum bilirubin at phototherapy discontinuation (mg/dL), median [IQR]	12 [10.8–13.2]
Total serum bilirubin at discharge (mg/dL), median [IQR]	12.1 [10.75–13.3]

SD: standard deviation; FT: phototherapy; IQR: interquartile range.

3.4. READMISSIONS

All infants discharged immediately who developed rebound were successfully managed with hospital readmission and PT reinitiation. No differences in overall readmission rates were observed.

3.5. INTERPRETATION

The low incidence of rebound and its detection mostly in outpatient follow-up suggest that routine in-hospital monitoring after PT is not necessary for otherwise healthy newborns; targeted observation may be reserved for high-risk infants.

Table 2: Summary and comparison of main characteristics of newborns discharged after phototherapy versus those who remained hospitalized for post-treatment bilirubin monitoring			
Variable	**Discharged (n=95)**	**Remained hospitalized for monitoring (n=60)**	**Significance**
Female sex, n (%)	50 (52.6)	30 (50)	NS
Gestational age (weeks), mean (SD)	38.4 (1.6)	38.14 (1.6)	NS
<38 weeks gestation, n (%)	53 (55.7)	27 (45)	NS
Birth weight (g), mean (SD)	3194 (542.9)	3086.9 (441.7)	NS
Age at admission (hours), median [IQR]	60 [48–94.5]	60 [50–79]	NS
Admitted from maternity ward, n (%)	54 (56.8)	39 (65)	NS
Percentage weight loss at admission, median [IQR]	6.9 [5.3–8.3]	6.6 [5–8.7]	NS
Total serum bilirubin at admission (mg/dL), median [IQR]	17 [15.7–19.5]	18 [16.1–20.2]	NS
Total phototherapy duration (hours), median [IQR]	24 [20–36]	30 [24–36]	NS
Total length of stay (days), median [IQR]	1 [1–2]	2 [2–3]	P = 0.053
Serum bilirubin at end of phototherapy (mg/dL), median [IQR]	11.9 [10.8–13.05]	12.2 [10.7–13.5]	NS
Bilirubin rebound, n (%)	4 (4.2)	1 (1.6)	NS

NS: not significant; SD: standard deviation; IQR: interquartile range.

Table 3: Summary of baseline characteristics of newborns with rebound hyperbilirubinemia						
Variable	**Patient 1**	**Patient 2**	**Patient 3**	**Patient 4**	**Patient 5**	**Median (IRQ) / N (%)**
Gestational age (weeks)	37	37	41	39	35	37 (36-40)
Sex	Female	Male	Male	Female	Female	Female: 3 (60%)
Birth weight	3075	3025	3895	2885	2280	3025 (2582.5-3485)
Risk factor for hyperbilirrubinemia	No	No	Yes (isounmunization)	No	No	No: 4 (80%)
Isoimmunization	No	No	Yes (anti-A)	No	No	No: 4 (80%)
Exclusive breastfeeding	No	No	No	Yes	No	No: 4 (80%)
Total serum bilirubin at start of phototherapy (mg/dL)	21,7	14,5	14	20	16,1	16.1 (14.25-20.85)
Age at admission (hours)	75	40	35	48	48	48 (37.5-61.5)
Percentage weight loss at admission	8,3	3,6	3,8	3	8,6	3.8 (3.31-8.4)
Phototherapy duration (hours)	59	18	135	48	48	48 (33-97)
Length of stay (days)	6	5	7	3	2	5 (2.5-6.5)
Total serum bilirubin at phototherapy discontinuation	13,5	12	13	13,4	13,8	13.4 (12.5-13.65)
Remained hospitalized for monitoring	Yes	No	Yes	No	Yes	Yes: 3 (60%)
Total serum bilirubin at discharge (mg/dL	18	Same as time of discontinuation	12,6	Same as time of discontinuation	14,1	14.1 (12.6-14.1)
Bilirubin rebound detection	During hospitalization	Outpatient follow up	Outpatient follow up	Outpatient follow up	Outpatient follow up	Outpatient followup: 4 (80%)

SD: standard deviation; FT: phototherapy; IQR: interquartile range.

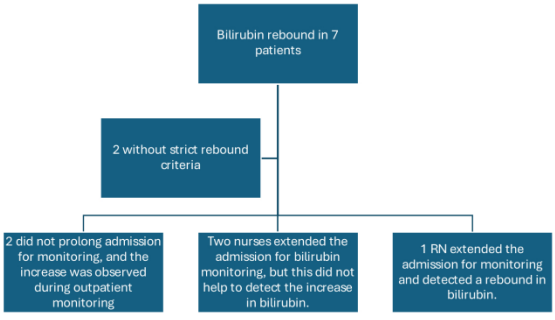

Figure 1: *Summary of patients presenting with bilirubin rebound and how this rebound was detected.*

4. DISCUSSION

In this cohort, clinically significant rebound after PT discontinuation was infrequent (3.2%) and mostly detected during outpatient follow-up rather than during inpatient observation. These findings indicate that routine prolongation of hospitalization solely to monitor for rebound has low yield and may unnecessarily extend hospital stay.

Earlier studies reported rebound incidences of 10–13%, with higher risk in preterm infants, Coombs-positive infants, and those receiving early PT [7]. More cohorts that are recent report lower rates, especially when conservative discontinuation criteria are applied. Chang et al. developed clinical prediction rules including gestational age, PT initiation age, and TSB at discontinuation; most term infants had <4% risk of rebound when PT was stopped ≥2 mg/dL below threshold [8, 9]. External validations show modest discrimination, highlighting the need for context-specific adaptation [11].

Additional risk factors—low birth weight, hemolysis,

suspected sepsis, or intensive PT exposure—may justify closer monitoring [10]. In middle-income settings, significant rebound (~10%) was associated with birth weight <2000 g, prematurity, ABO/Rh incompatibility, and G6PD deficiency [13]. These data reinforce that rebound risk is heterogeneous and should be stratified.

Our results support AAP recommendations emphasizing discharge risk assessment and limiting routine inpatient monitoring in low-risk infants [12]. Spanish guidelines similarly stress individualized follow-up planning [5]. Targeted observation may be warranted for hemolysis, gestational age <38 weeks, or PT initiation within 48 hours of life. Post-discharge follow-up with clinical evaluation and, if indicated, laboratory testing within 24–48 hours detects most rebounds without prolonging hospitalization. Home phototherapy is safe in selected newborns with daily monitoring and rapid access to readmission, potentially reducing costs and improving family experience [14].

However, these findings should be interpreted in the context of an important limitation: patient management in this cohort was based on the 2004 American Academy of Pediatrics guideline, as data collection preceded implementation of the updated 2022 hyperbilirubinemia guideline at our institution [15]. The updated guideline provides more precise recommendations for post-phototherapy follow-up, which may directly influence rebound detection and therefore the observed outcomes. In contrast, under previous guidance, recommendations for post-discontinuation monitoring were less clearly defined, and follow-up decisions largely depended on the judgment of the attending clinician. Future studies incorporating the updated guideline into routine clinical practice would be valuable to validate these findings. Future studies incorporating the updated guideline into routine clinical practice would be valuable to validate these findings.

Strengths include analysis of a consecutive cohort, clear rebound definition, and structured follow-up. Limitations are: (1) limited power due to low number of events, (2) retrospective single-center design, (3) absence of a priori sample size calculation, (4) lack of socioeconomic/family environment data, and (5) follow-up limited to the first month.

5. CONCLUSIONS

Clinically significant rebound after phototherapy discontinuation was uncommon in our cohort and was rarely detected during immediate inpatient observation. These findings suggest that, in selected low-risk term newborns with reliable outpatient follow-up availability, routine prolongation of hospitalization solely for rebound monitoring may not be necessary. Instead, outpatient reassessment within 24–48 hours after phototherapy discontinuation may represent a reasonable approach. However, infants with higher-risk profiles, including hemolysis, lower gestational age, or early phototherapy initiation, may still require closer monitoring and individualized management. Given the retrospective single-center design, the relatively small sample size, and the limited number of rebound events, these results should be interpreted with caution.

6. CONFLICT OF INTERESTS

The authors have no conflict of interest to declare. The authors declared that this study has received no financial support.

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