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ORIGINAL

Phototherapy as a treatment for hyperbilirubinemia: the influence of newborn's weight and feeding on treatment effectiveness

Fototerapia como tratamiento de hiperbilirrubinemia: la influencia del peso y alimentación del recién nacido en la efectividad del tratamiento

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ABSTRACT

Introduction: neonatal hyperbilirubinemia, the main cause of jaundice, requires timely treatment to prevent complications. Phototherapy is the standard method, but its efficacy may vary according to factors such as neonatal weight and feeding.
Objective: to evaluate the influence of neonatal weight, type of feeding and other variables on the effectiveness of phototherapy.
Method: retrospective study of 89 term newborns (≥37 weeks) hospitalized in Buenos Aires (2023-2024). Clinical histories were analyzed, recording weight, type of breastfeeding (exclusive/mixed), bilirubin levels at admission and evolution after 24/48 hours of phototherapy.
Results: newborns with mixed breastfeeding had higher initial bilirubin levels (17,41 mg/dL vs. 14,79 mg/dL; p=0,03). At 48 hours, there was no significant difference in reduction (21,92 % vs. 25,45 %; p=0,665). Neonates with weight loss >7 % showed higher initial levels (16,57 mg/dL vs. 14,77 mg/dL; p=0,33), with no subsequent differences in treatment efficacy.
Conclusions: exclusive breastfeeding was associated with lower initial bilirubin levels, but did not significantly influence the efficacy of phototherapy. Mixed feeding and postnatal weight loss could be relevant factors in the initial evaluation, although studies with greater statistical power are required.

Keywords: Newborn; Phototherapy; Bilirubin; Neonatal Hyperbilirubinemia.

RESUMEN

Introducción: la hiperbilirrubinemia neonatal, principal causa de ictericia, requiere tratamiento oportuno para prevenir complicaciones. La fototerapia es el método estándar, pero su eficacia puede variar según factores como el peso y la alimentación del recién nacido.
Objetivo: evaluar la influencia del peso neonatal, tipo de alimentación y otras variables en la efectividad de la fototerapia.
Método: estudio retrospectivo con 89 recién nacidos a término (≥37 semanas) hospitalizados en Buenos Aires (2023-2024). Se analizaron historias clínicas, registrando peso, tipo de lactancia (exclusiva/mixta), niveles de bilirrubina al ingreso y su evolución tras 24/48 horas de fototerapia.
Resultados: los recién nacidos con lactancia mixta presentaron niveles iniciales más altos de bilirrubina (17,41 mg/dL vs. 14,79 mg/dL; p=0,03). A las 48 horas, no hubo diferencias significativas en la reducción (21,92 % vs. 25,45 %; p=0,665). Los neonatos con pérdida de peso >7 % mostraron niveles iniciales más elevados (16,57 mg/dL vs. 14,77 mg/dL; p=0,33), sin diferencias posteriores en la eficacia del tratamiento.
Conclusiones: la lactancia exclusiva se asoció a menores niveles iniciales de bilirrubina, pero no influyó significativamente en la eficacia de la fototerapia. La alimentación mixta y la pérdida de peso posnatal podrían ser factores relevantes en la evaluación inicial, aunque se requieren estudios con mayor potencia

estadística.

Palabras clave: Recién Nacido; Fototerapia; Bilirrubina; Hiperbilirrubinemia Neonatal.

INTRODUCTION

Jaundice derives from the French word jaune, meaning yellow.[1] It is the most frequently encountered medical condition in the first 2 weeks of life and a common cause of hospital readmission after birth.[2] Jaundice is caused by hyperbilirubinemia (high serum bilirubin concentration).[3,4,5] Serum bilirubin levels that cause jaundice vary by skin color and body region, but jaundice is visible in the sclera at 2 to 3 mg/dL (34 to 51 micromol/L) and in the face at 4 to 5 mg/dL (68 to 86 micromol/L). With increasing bilirubin levels, jaundice progresses from head to toe, appearing at the umbilicus at 15 mg/dL (257 micromol/L) and the feet at 20 mg/dL (342 micromol/L).[6,7]

Approximately 60 % of term newborns and 80 % of preterm newborns develop clinical jaundice in the first week after birth.[2,8] Early identification of hyperbilirubinemia is crucial to prevent serious complications, such as kernicterus (bilirubin encephalopathy).

The primary method to decrease hyperbilirubinemia levels is phototherapy, a safe and innocuous method that reduces serum bilirubin through photoisomerization of unconjugated bilirubin, facilitating its excretion in bile.[9] However, rare associations have been described, such as the subclinical risk of carcinogenesis, negative effects in extremely low-weight babies, and tan baby syndrome.[10,11]

Regarding the enterohepatic metabolism of bilirubin, it is important to mention that it involves several stages. Bilirubin is formed by heme degradation, mainly from the hemoglobin of old red blood cells, converting first to biliverdin and then to unconjugated (water-insoluble) bilirubin. In the liver, unconjugated bilirubin is taken up by hepatocytes and conjugated with glucuronic acid by the enzyme UDP-glucuronosyltransferase, forming conjugated (water-soluble) bilirubin.[5]

Conjugated bilirubin is secreted into the bile and transported to the small intestine. In the intestine, it can be deconjugated by bacterial enzymes and converted to urobilinogen. The intestine reabsorbs Part of the urobilinogen and transmits it to the liver through the portal circulation.[12,13] Another part is excreted in the feces as stercobilin (giving it a brown color) and in the urine as urobilin (giving it a yellow color).[5,7]

In newborns, especially those with feeding difficulties, hepatic immaturity, and increased red blood cell destruction can result in elevated levels of unconjugated bilirubin, leading to jaundice. Inadequate lactation may also reduce intestinal motility and excretion of conjugated bilirubin in the feces.[14,15]

Studies on the incidence of hyperbilirubinemia in newborns state that infants with hyperbilirubinemia experienced greater postnatal weight loss compared to the general population and that there was a significant correlation between supplemental feeding and elevated bilirubin levels.[3]

How do different variables (such as feeding, neonatal weight, or hepatic metabolism) influence the efficacy of treatment of hyperbilirubinemia in newborns?

Objective

To evaluate the behavior of different variables on the efficacy of treatment of neonatal hyperbilirubinemia.

METHOD

Study Design

A descriptive retrospective cohort search was performed to evaluate the behavior of different variables related to the incidence of neonatal jaundice, levels of hyperbilirubinemia, weight variation, and type of feeding in term newborns.

Study Population

Term newborns admitted to the Hospital Especializado Materno Infantil de Agudos Ana Goitia in the Province of Buenos Aires, born between 2023 and 2024.

Inclusion Criteria

- Term newborns (older than 37 weeks).
- With adequate weight for gestational age (2500 grams).
- With a diagnosis of neonatal hyperbilirubinemia according to the American Academy of Pediatrics, with values of the 2022 revision.
- They were hospitalized together with their mother.
- Exposed to luminotherapy.

Exclusion Criteria

- Newborns with congenital diseases.
- Newborns with cardiopathies.
- Newborns born prematurely.
- Newborns with low birth weight.
- Newborns with sepsis.
- Newborns with liver disease.
- Newborns with major blood incompatibilities (RH and ABO).

Selection and Sample Size

Not measurable.

Scope of the study

The research was conducted in a hospital setting under the supervision of the counselor, a professor at the same university.

Operational description of the variables

- Birth weight expressed in grams: continuous quantitative.
- APGAR (score that evaluates the newborn's condition): discrete quantitative.
- Current weight: continuous quantitative.
- Cesarean section or delivery: qualitative dichotomous.
- Percentage of weight loss at the time of admission to luminotherapy: quantitative.
- Bilirubin value at luminotherapy admission: continuous quantitative.
- Type of feeding at luminotherapy admission: qualitative nominal.
- Mother's age: continuous quantitative.
- Gestational age: continuous quantitative.
- Group and factor (blood group and Rh factor): nominal qualitative.
- Sex (female and male): qualitative dichotomous.
- Type of breastfeeding (breast, breast and bottle, bottle): qualitative nominal.
- Weight gain: continuous quantitative.
- Total bilirubin level expressed in mg/dl at admission: continuous quantitative.
- Rate of bilirubin decrease 24 hours after treatment: continuous quantitative.
- Rate of bilirubin decrease 48 hours after treatment: continuous quantitative.
- Total days in luminotherapy: discrete quantitative.

RESULTS

The parameters evaluated included:

Estatísticos Descritivos	N	Mínimo	Máximo	Média	Desv. Típ.
Idade Materna (EM)	89	16,00	45,00	26,09	6,54
Idade Gestacional (EG)	89	37,00	41,10	38,69	1,23
Parto (VNDICO)	89	-	-	0,62	-
Peso ao Nascer (PN)	89	2200,0	4450,00	3263,03	468,36
Tipo Sanguíneo (ANEG)	89	-	-	0,01	-
Tipo Sanguíneo (APOS)	89	-	-	0,44	-
Tipo Sanguíneo (ABPOS)	89	-	-	0,01	-
Tipo Sanguíneo (BPOS)	89	-	-	0,13	-
Tipo Sanguíneo (OPOS)	89	-	-	0,37	-
Alimentação	89	-	-	0,74	-
N Válido (segundo lista)	88	-	-	-	-

Figure 1. Demographic and Clinical Characteristics of the Study Population

An analysis of 89 medical records was performed at the Hospital Especializado Materno Infantil de Agudos Ana Goitia.

Maternal age: mean 26 years (Standard deviation: 6,5; Age range: 16 to 45 years).

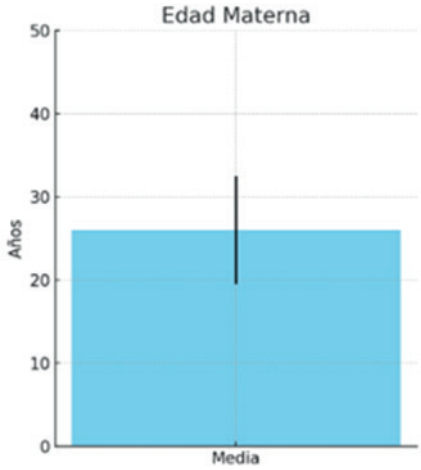

Figure 2. Descriptive statistics

Gestational age: mean 38,6 weeks (Standard deviation: 1,23; Range: 37 to 41,10 weeks).

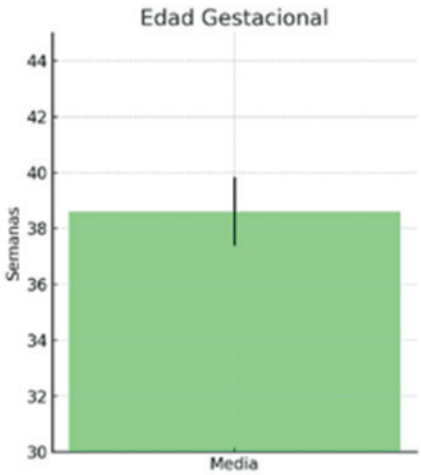

Figure 3. Descriptive statistics

Birth Weight: average weight of 3263,03 g (Standard deviation: 468,36 g).

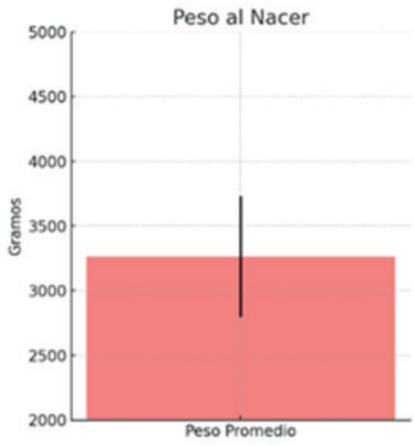

Figure 4. Descriptive statistics

Blood type: distribution of blood types: A positive (43,82 %), O positive (37,08 %), B positive (13,48 %), AB

positive (1,12 %) and A negative (1,12 %).

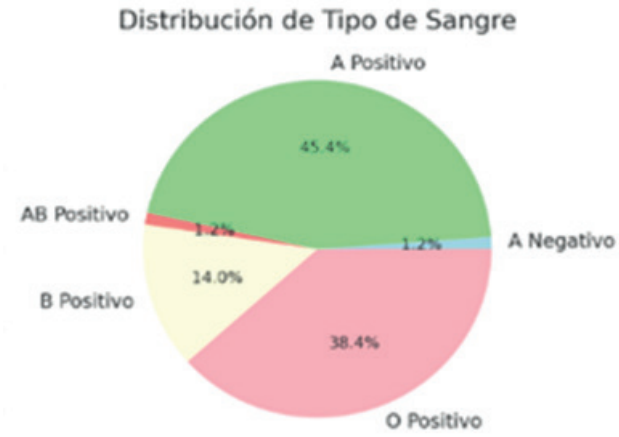

Figure 5. Blood type distribution

	GRUPO 1 LACTANCIA EXCLUSIVA	GRUPO 2 LACTANCIA MIXTA	P
BILI INGRESO	N:66 **14.79** DS 3.37	N:23 **17.41** DS 3.76	**0.03**
BILI 24 HS	N:66 **13.33** DS 2.68	N:23 **14.42** DS 3.24	0.118
BILI 48 HS	N:64 **11.01** DS 2.89	N:21 **12.19** DS3.9	0.215
%DE DESCENSO 48 HS	N: 64 **21.92** DS: 27,98	N:22 **25,45** DS:31,48	0.665

Figure 6. Analysis of Food and Bilirubin Variation

Bilirubin levels at admission were analyzed in two groups: exclusive breastfeeding and mixed breastfeeding.
Bilirubin at admission:

- Group 1: (Exclusive Breastfeeding): N = 66, mean 14,79 mg/dL (Standard deviation: 3,37).
- Group 2: (Mixed Breastfeeding): N = 23, mean 17,41 mg/dL (Standard deviation: 3,76), with P = 0,03.

A significant difference was observed between groups, where mixed breastfeeding infants had higher initial bilirubin levels.
Bilirubin at 24 hours:

- Group 1: mean = 13,33 mg/dL (Standard deviation: 2,68).
- Group 2: mean = 14,42 mg/dL (Standard deviation: 3,24); P = 0,118.

There was no significant difference in this period.
Bilirubin at 48 hours:

- Group 1: mean = 11,01 mg/dL (Standard deviation: 2,89).
- Group 2: mean = 12,19 mg/dL (Standard deviation: 3,9); P = 0,215.

No statistically significant difference was found after 48 hours.
Percentage of Bilirubin Decrease at 48 hours:

- Group 1: 21,92 % (Standard deviation: 27,98).
- Group 2: 25,45 % (Standard deviation: 31,48); P = 0,665.

There were no significant differences between the groups.

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Weight and Bilirubin Variation:

- Group 1: greater than 7 % weight decrease.
- Group 2: less than 7 % weight loss.

	GRUPO 1 MAYOR DE 7% DE DESCENSO DE PESO	GRUPO 2 MENOR DE 7% DE DESCENSO DE PESO	P
BILI INGRESO	N:42 **16,57** DS:3,41	N: 36 **14,77** DS:3,92	0,033
BILI 24 HS	N :42 **13,23** DS:2,76	N:36 **13,23** DS3,08	0,41
BILI 48 HS	N:39 **11,13** DS:2,98	N: 35 **10,86** DS:2,86	0,69
% DE DES 48	N: 40 **30,86** DS:16,30	N: 35 **21,33** DS:31,38	0,097

Figure 7. Descriptive statistics

Bilirubin at admission according to weight:

- Group 1 (Greater than 7 % weight decrease): N = 42, mean = 16,57 mg/dL (Standard deviation: 3,41).
- Group 2 (Less than 7 % weight loss): N = 36, mean = 14,77 mg/dL (Standard deviation: 3,92); P = 0,33.

Although there was no significant difference, heavier newborns tended to have higher bilirubin levels on admission. This supports the hypothesis that newborns with greater body mass have a higher circulating bilirubin load.

Bilirubin at 24 hours:

- Both groups had similar bilirubin means, with P = 0,41, indicating that phototherapy was equally effective in this period.

Bilirubin at 48 hours:

- Group 1: mean = 11,13 mg/dL (Standard deviation: 2,98).
- Group 2: mean = 10,86 mg/dL (Standard deviation: 2,86); P = 0,69.

No significant differences were found in bilirubin levels after 48 hours of phototherapy.

Percentage of Bilirubin Decrease at 48 hours:

- Group 1: 30,86 % (Standard deviation: 16,30).
- Group 2: 21,33 % (Standard deviation: 31,38); P = 0,097.

Although the percentage of decline was higher in the higher-weight group, this difference was not statistically significant.

DISCUSSION

Although lactation is not related to the efficiency of immunotherapy, it is observed that infants exclusively breastfed enter with a lower bilirubin value.[16]

Type of Feeding: newborns receiving mixed feeding (breast plus supplementation) enter with higher bilirubin values than those exclusively breastfed.

Decreased Weight

- Those with a weight loss greater than 7 % also have higher bilirubin values.
- Those exclusively breast-fed do not show a significant difference in bilirubin decrease, although there is a slight difference (21,92 and 25,45).
- In those who experience a greater decrease in weight, the values are (30,86 and 21,33), which indicates a relevant, although not significant, difference.

Effect on Bilirubin at 48 Hours

Exclusively breastfed infants decrease their bilirubin by 21 % at 48 hours, compared with a 25 % decrease in

mixed-breasted infants.

- This suggests that, although complementary feeding does not make a significant difference, it may contribute to a greater reduction in bilirubin.
- As for the percentage of weight loss, the higher the percentage of weight loss, the lower the values at 48 hours by 30 % compared to 21 %, although this difference is not significant.

CONCLUSIONS

The descriptive and retrospective study based on information from 89 medical records of newborns on monotherapy suggests that, although exclusive breastfeeding does not significantly influence the efficiency of immunotherapy, it is associated with lower bilirubin levels on the admission of newborns. In addition, mixed feeding and greater weight loss are associated with higher bilirubin values at admission. Although exclusively breast-fed newborns show a decrease in bilirubin levels at 48 hours, this decrease is less pronounced than those receiving mixed feeding. Despite not showing significant differences, these results indicate that complementary feeding could play an important role in bilirubin reduction. Therefore, it is essential to consider both the type of feeding and weight loss in evaluating and managing neonatal hyperbilirubinemia.

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FINANCING

None.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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Data curation: Gabriela Fernandes Ferreira, Carlos Juan Vidal.
Formal analysis: Gabriela Fernandes Ferreira, Carlos Juan Vidal.
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Resources: Gabriela Fernandes Ferreira, Carlos Juan Vidal.
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