

COMPARISON OF THE CURRENT PRACTICE WITH THE AMERICAN ACADEMY OF PEDIATRICS GUIDELINES IN THE MANAGEMENT OF NEONATAL HYPERBILIRUBINEMIA IN AL-FALLUJAH TEACHING HOSPITAL FOR MATERNITY AND CHILDHOOD: A CROSS SECTIONAL STUDY

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ABSTRACT

Background: The current practice of the management of neonatal hyperbilirubinemia varied among doctors in Iraq. There is no national guideline and most of the decision making by doctors depend either on evidence-based practices or on the published criteria of other national guidelines such as the American Academy of Pediatrics (AAP) guidelines for the management of neonatal hyperbilirubinemia. **Objectives:** The objectives of this study are to estimate the incidence of neonatal hyperbilirubinemia in Al-Fallujah city; to identify the risk factors that can predict severe hyperbilirubinemia in newborns; and to compare the doctors' practice in management of neonatal hyperbilirubinemia in Al-Fallujah teaching hospital for maternity and childhood with the AAP guidelines for the management of neonatal hyperbilirubinemia. **Methods:** This was a cross sectional study design. All the newborns admitted to the neonatal unit at Al-Fallujah teaching hospital for maternity and childhood suffering from neonatal hyperbilirubinemia and received phototherapy from 1st January 2017 to 31st December 2017 were included in the study. The data was de-identified. The demographic characteristics and the established risk factors were collected. The outcomes were newborns met AAP criteria for phototherapy, underwent exchange transfusion and met AAP criteria for exchange transfusion. The distribution of demographic characteristics and neonatal factors was presented in number and percentages. The continuous variables were presented as mean and standard deviation (SD) and range. We calculated the incidence of neonatal hyperbilirubinemia. We used univariable and multivariable analyses to estimate the association of the risk factors with each outcome by calculating the odds ratio (OR) and 95% confidence interval (CI). We used kappa statistical test to compare the level of agreement of the current practice in the management of neonatal hyperbilirubinemia with the AAP criteria for phototherapy and exchange transfusion. **Results:** 426 newborns with neonatal hyperbilirubinemia were included in the study. The incidence of neonatal hyperbilirubinemia was 419 per 10,000 live births and of exchange transfusion was 21 per 10,000 live births. The mean age of newborns at admission was 5.3 days (SD 2.9). Rh and ABO incompatibilities were the main risk factors of severe hyperbilirubinemia that needed exchange transfusion and complementary phototherapy (AOR 16.10, 95% CI 2.52-102.95, AOR 6.02 (0.97-37.24) respectively). Out of 22 newborns underwent exchange transfusion, only 5 newborns (22.7%) did not met the AAP criteria for exchange transfusion with kappa test of 0.87 indicating acceptable level of agreement between the doctors' decisions and the AAP guidelines criteria for exchange transfusion. **Conclusion:** Neonatal hyperbilirubinemia is highly incident in Iraq due to unnecessary hospital admissions. The current practice in the management of neonatal hyperbilirubinemia is consistent with the AAP guidelines recommendation for exchange transfusion but not for phototherapy. Newborns with Rh or ABO incompatibilities are at higher risk of severe hyperbilirubinemia and exchange transfusion. Further researches and development are needed.

KEYWORDS: Al-Fallujah, exchange transfusion, neonatal hyperbilirubinemia, phototherapy, risk factors.

INTRODUCTION

Neonatal hyperbilirubinemia is a common neonatal health problem.^[1] Approximately 60% of term infants and 80% of preterm infants develop hyperbilirubinemia during the first week of life.^[2] In most cases, hyperbilirubinemia is benign problem in neonates and can be progressed to a severe form called “severe hyperbilirubinemia”.^[3] The severe form of hyperbilirubinemia can lead to a neurodevelopmental sequelae “bilirubin encephalopathy (kernicterus)” if not managed properly.^[3] Early intervention and proper management of neonatal hyperbilirubinemia can improve the outcome and prevent complications.^[4,5]

There is no international guideline for management of neonatal hyperbilirubinemia to be implemented in the current practice. The American Academy of Pediatrics (AAP) 2004 guidelines issued criteria the management of neonatal hyperbilirubinemia in healthy, at-risk, and near-term newborns.^[6] In the health institutions where the national guidelines are not available for management of neonatal hyperbilirubinemia, the doctors mostly follow the textbook.^[7] or the published guidelines in the management and few evidences showed that the use of these guidelines improved the outcomes and minimize the interventions.^[8-10]

Slusher et al 2017 systematic review estimated the incidence of sever hyperbilirubinemia in East Mediterranean was 165.7 per 10000 live births and the incidence of exchange transfusion was 17.8 per 10000 live births.^[11] In Jordan, Khassawneh et al 2013 estimated lower rates and reported the incidence of neonatal hyperbilirubinemia was 76 per 10000 live births, and of exchange transfusion was 0.13%. The study also compared the practice of the local pediatrician in management of neonatal hyperbilirubinemia with the AAP guidelines and reported half of newborns admitted with neonatal hyperbilirubinemia exposed to unnecessary phototherapy and exchange transfusion according to the AAP criteria.^[12]

A study conducted in Iran and included 643 newborns showed that 11.8% had significant jaundice and required intervention.^[13] Tiker et al (2006) study of 774 hospitalized infants in Turkey suffered neonatal jaundice estimated 93 newborns (12%) had total serum bilirubin (TSB) ≥ 25 mg/dl (≥ 428 $\mu\text{mol/L}$) and 33 newborns (35.5%) had TSB ≥ 30 mg/dl (≥ 513 $\mu\text{mol/L}$).^[14]

In Iraq, there is no standard national guideline for management of neonatal hyperbilirubinemia and the management is varied from doctor to another and depend mostly either on evidence-based practices or on the published guidelines such as the AAP guidelines. We are not aware about any published population-based data for neonatal hyperbilirubinemia in Iraq. Hameed et al 2011 study recruited 162 newborns with neonatal hyperbilirubinemia from a single centre in Baghdad and estimated the incidence of neonatal hyperbilirubinemia

322 per 10,000 live births (162/5033).^[15] Other study included 100 newborns over one-month period compared the neonatal outcomes for use of traditional phototherapy with extensive phototherapy according to the AAP guidelines. It concluded that the use of extensive phototherapy improved the outcomes.^[16] Therefore, there is a need to establish a national guideline in Iraq for the management of neonatal hyperbilirubinemia to reduce the gap between the current practice and the published guidelines.

The AAP guidelines for the management of neonatal hyperbilirubinemia has listed the risk factors of neonatal hyperbilirubinemia.^[6] The guidelines recommend to testing TSB level before discharge. If TSB fall in the high-risk zone or a rapid rate of TSB rise, the newborn needs closely follow up.^[17,18] Despite ABO and Rh incompatibilities are important risk factors of neonatal hyperbilirubinemia,^[17,19] they are not significantly associated with the disease in a study conducted in Iraq (odds ratio (OR) 0.72, 95% confidence interval (CI) 0.37–1.40).^[15] Other established risk factors by guidelines are: glucose 6 phosphate dehydrogenase (G6PD) deficiency, cephalohematoma and bruising, hemolytic diseases (such as hereditary spherocytosis and pyruvate kinase deficiency), preterm babies, exclusive breastfeeding, family history of neonatal hyperbilirubinemia in siblings, male sex and infant of diabetic mother.^[20-27]

Elevated indirect hyperbilirubinemia in a newborn with abnormal clinical manifestations cause should be screened to role out sepsis.^[28] A study conducted in Iraq reported increased, but not significant, risk of neonatal hyperbilirubinemia in newborn diagnosed with sepsis (OR 1.31, 95% CI 0.51–3.39).^[15]

The objectives of this study are: to estimate the incidence of neonatal hyperbilirubinemia in Al-Falluja city; to identify the risk factors that can predict severe hyperbilirubinemia in newborns; and to compare the doctors' practice in management of neonatal hyperbilirubinemia in Al-Fallujah teaching hospital for maternity and childhood with the AAP guidelines for management of neonatal hyperbilirubinemia.

MATERIALS AND METHODS

This was a cross sectional study of retrospectively collecting data of newborns admitted to neonatal care unit at Al-Fallujah teaching hospital for maternity and childhood from 1st January 2017 to 31st of December 2017 and suffer from neonatal hyperbilirubinemia. The data was de-identified and the study was approved by Al-Fallujah teaching hospital for maternity and childhood ethics committee. The inclusion criteria were admission of newborn to the neonatal ward diagnosed with neonatal hyperbilirubinemia and received phototherapy. The medical information was obtained from the hospital records with the filling of a structured questionnaire including the potential risk factors of neonatal

hyperbilirubinemia. The variables included: newborn age at admission (categorical: >5 days, 2-5 days, ≤1 day; continuous), gender, residency (Al-Fallujah city vs villages), weight (categorical: ≥2500 gm, 1500-2499 gm, <1500 gm; continuous), date of admission, date of discharge, duration of stay in the hospital, associated sepsis (yes vs no), peak TSB (<20 mg/dl, 20-24.9 mg/dl, ≥25 mg/dl), packed cell volume-PCV (≥35, <35), blood group of mothers and babies to determine Rh and ABO incompatibilities.

The distribution of the demographic characteristics and neonatal factors was presented in number and percentages. The continuous variables, including age at admission (days), weight (gram), duration of hospital stay, peak TSB (mg/dl) level and peak PCV level were presented as mean and standard deviation (SD) and range. We tested the normality of the distribution of the continuous variables and presented in histograms.

The outcomes were newborn met the AAP phototherapy; underwent exchange transfusion; and newborns met AAP criteria for exchange transfusion.

We calculated the incidence of neonatal hyperbilirubinemia per 10000 live births and the rates of the outcomes.

We used the univariable analysis to estimate the individual association of the independent risk factors with each outcome by calculating the odds ratio (OR) and 95% confidence interval (CI). A multivariable logistic regression models was used to calculate the adjusted odds ratio (AOR) and 95% CI for each risk factor association with the outcome after adjusting for the other risk factors in the model.

We compared the level of agreement of the current practice in the management of neonates using phototherapy and exchange transfusion with the AAP criteria for phototherapy and exchange transfusion using kappa statistics (-1=perfect disagreement, 0=no agreement beyond chance, 1=perfect agreement).

A p-value of 0.05 as statistically significant was considered for all analyses. The SPSS software version 24 was used in the statistical analysis.

RESULTS

426 newborns with neonatal hyperbilirubinemia fulfilled our study inclusion criteria. According to Al-Falluja city statistics, there were 10170 live births in Al-Falluja city and the surrounding villages during 2017. The incidence of neonatal hyperbilirubinemia was 419 per 10,000 live births and of exchange transfusion was 21 per 10,000 live births. 1464 newborns were admitted to the neonatal unit during 2017. The rate of neonatal hyperbilirubinemia was 29% (426/1464).

Table 1. Characteristics of study population.

Characteristic	N (%)
Age at admission	
>5 days	171 (40.1)
2-5 days	228 (53.5)
≤1 day	27 (6.3)
Gender	
Female	174 (40.8)
Male	252 (59.2)
Residency	
Al-Fallujah	236 (55.4)
Villages	190 (44.6)
Sepsis	
No	418 (98.1)
Yes	8 (1.9)
Weight	
≥2500 g	297 (69.7)
1500-2499 g	126 (29.6)
<1500 g	3 (0.7)
Peak TSB level	
<20 mg/dl	373 (87.6)
20-24.9 mg/dl	46 (10.8)
≥25 mg/dl	7 (1.6)
Peak PCV level	
≥35	425 (99.8)
<35	1 (0.2)
ABO incompatibility	
No	324 (76.1)
Yes	102 (23.9)
RH incompatibility	
No	363 (85.2)
Yes	63 (14.8)
ABO & RH incompatibility	
No	396 (93.0)
Yes	30 (7.0)

PCV=packed cell volume; TSB=total serum bilirubin.

The distribution of the neonatal demographic characteristics and the potential risk factors are summarized in Table 1. Of the participants, 252 (59.2%) were males and 174 (40.8%) were females. 236 (55.4%) were residents of Al-Fallujah city while 190 (44.6%) were products of families live in the villages around the city (Figure 1). Only 8 (1.9%) newborn were reported clinical sepsis.

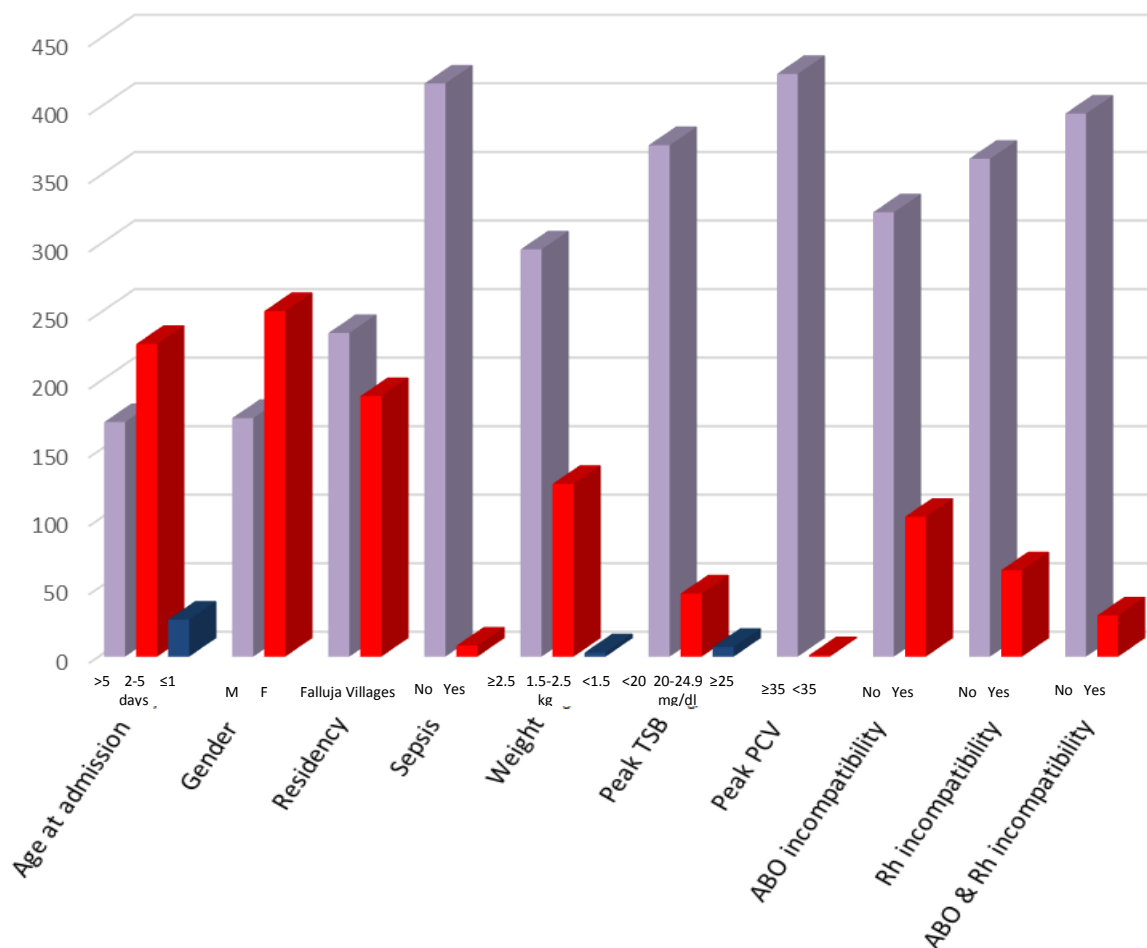


Figure 1: Distribution of the neonatal demographic characteristics and the potential risk factors.

The distribution of the continuous variable is shown in Table 2 and Figure 2. The mean age of newborns at admission was 5.3 days (SD 2.9). More than half of newborns ($n=228$, 53.5%) were admitted between two and five days of age while only 6.3% ($n=27$) were admitted within 24 hours of age. Majority of newborns ($n=297$, 69.7%) had a weight at or greater than 2500 gm. The mean weights of newborns at admission was 2739.6

gm (SD 562.2gm). The mean hospital stay was 2.3 (SD 2.0).

About 12% ($n=53$) of newborns had peak TSB levels at or above 20 mg/dl and only one newborn reported PCV below 35. The ABO incompatibility was reported in 102 (23.9%) while Rh incompatibility was observed in 63 (14.8%) newborns. 7% of newborns ($n=30$) had combined ABO and Rh incompatibilities.

Table 2: Distribution of the continuous variables.

Variable	N	Mean (SD)	Median (IQR)	Range
Age (days)	426	5.3 (2.9)	5.0 (3.0-7.0)	1.0-15.0
Weight (gram)	426	2739.6 (562.2)	2700.0 (2400.0-3000.0)	1300.0-4500.0
Duration of hospital stay (days)	426	2.3 (2.0)	2.0 (1.0-3.0)	1.0-27.2
Peak TSB (mg/dl)	426	15.0 (3.9)	14.5 (12.5-17.5)	4.5-30.0
Peak PCV	426	52.5 (6.5)	52.0 (48.0-57.0)	34.0-70.0

IQR=inter quartile range; PCV=packed cell volume; SD=standard deviation; TSB=total serum bilirubin.

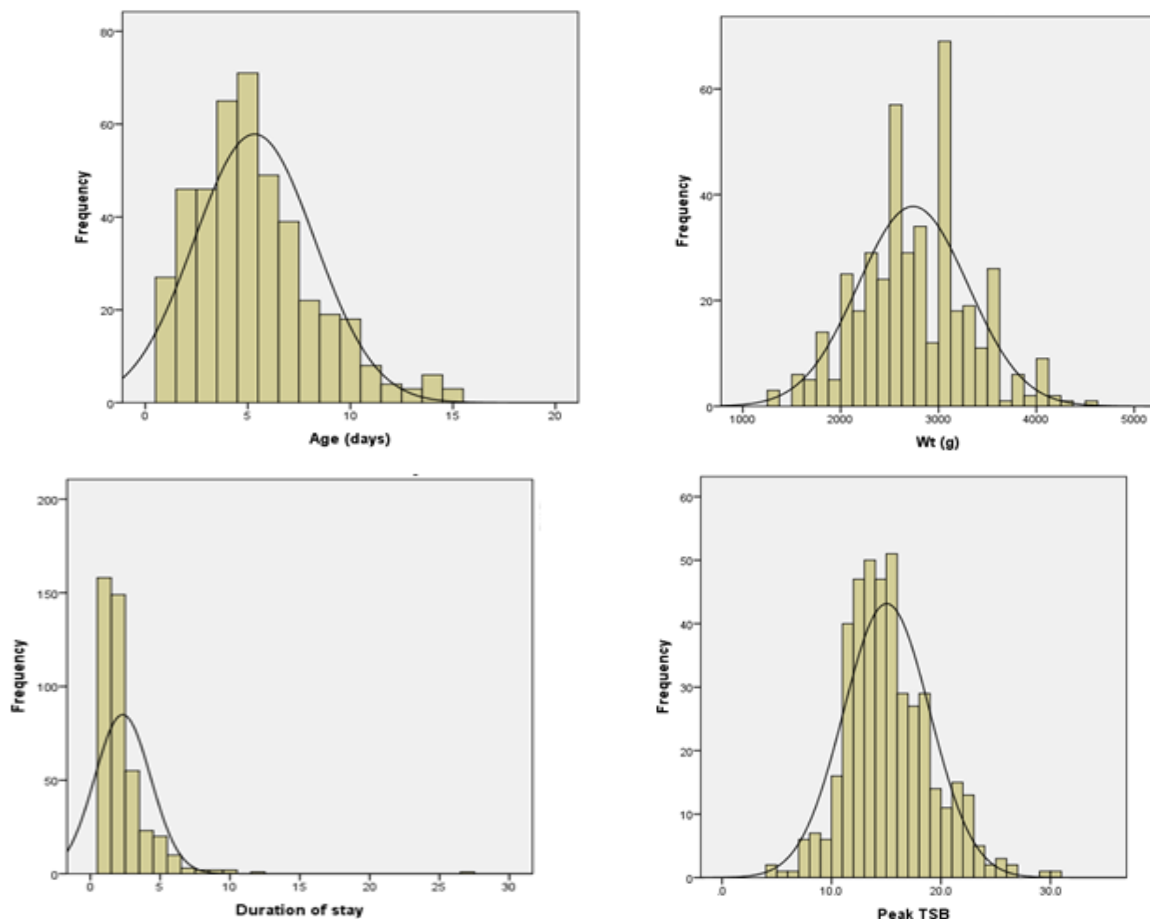
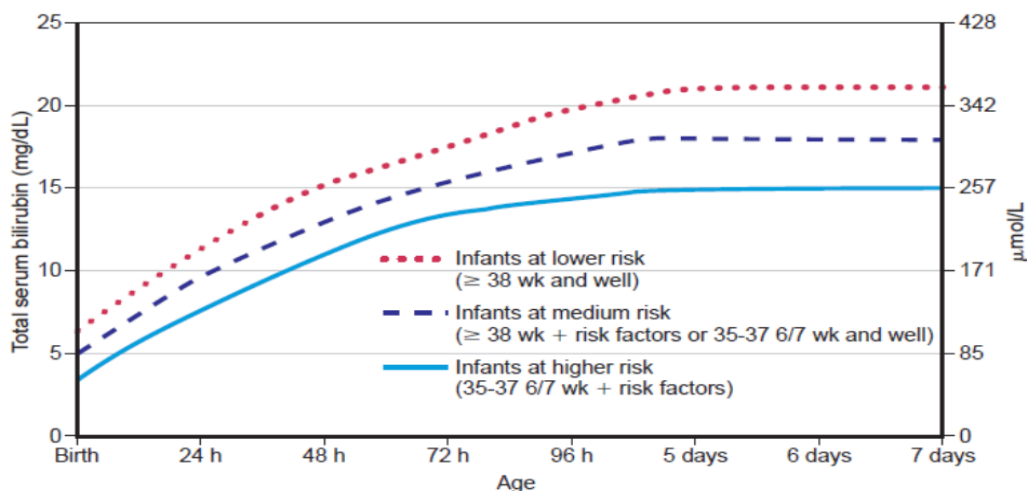
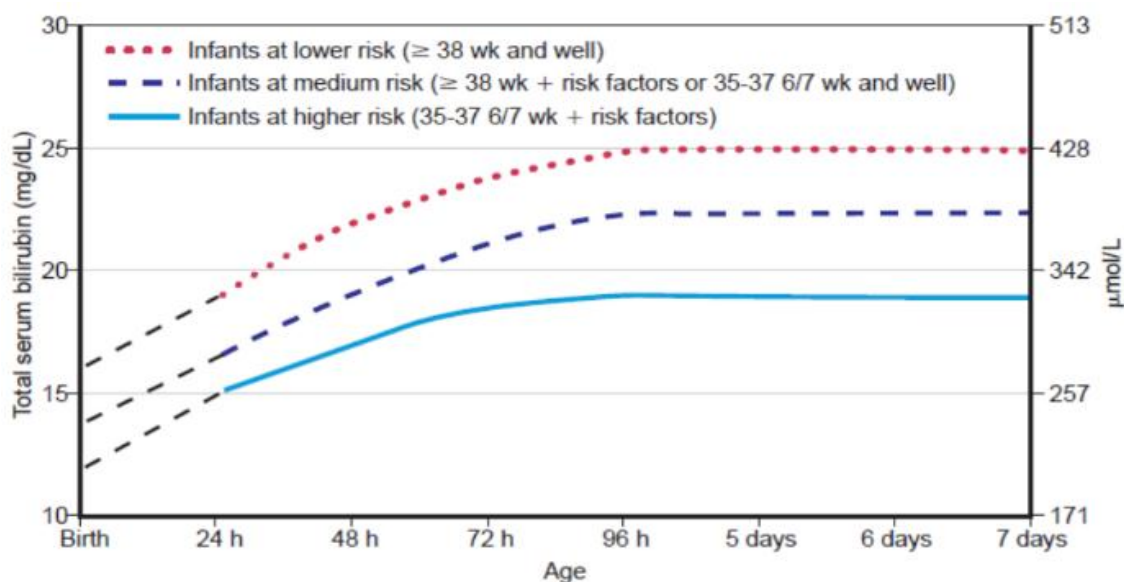


Figure 2: Distribution of the continuous variables: A) age at admission (days); B) weight (gm); C) duration of hospital stay (days); D) peak TSB level.

All newborns included in study received phototherapy and only 22 newborns (5.2%) underwent exchange transfusion (Table 3).



- Use total bilirubin. Do not subtract direct reacting or conjugated bilirubin.
- Risk factors = isoimmune hemolytic disease, G6PD deficiency, asphyxia, significant lethargy, temperature instability, sepsis, acidosis, or albumin < 3.0 g/dL (if measured).
- For well infants 35-37 6/7 wk can adjust TSB levels for intervention around the medium risk line. It is an option to intervene at lower TSB levels for infants closer to 35 wks and at higher TSB levels for those closer to 37 6/7 wk.
- It is an option to provide conventional phototherapy in hospital or at home at TSB levels 2-3 mg/dL (35-50 μmol/L) below those shown, but home phototherapy should not be used in any infant with risk factors.



- The dashed lines for the first 24 hours indicate uncertainty due to a wide range of clinical circumstances and a range of responses to phototherapy.
- Immediate exchange transfusion is recommended if infant shows signs of acute bilirubin encephalopathy (hypertonia, arching, retrocollis, opisthotonos, fever, high pitched cry) or if TSB is ≥ 5 mg/dL (85 $\mu\text{mol/L}$) above these lines.
- Risk factors = isoimmune hemolytic disease, G6PD deficiency, asphyxia, significant lethargy, temperature instability, sepsis, acidosis.
- Measure serum albumin and calculate B/A ratio (see legend).
- Use total bilirubin. Do not subtract direct reacting or conjugated bilirubin.
- If infant is well and 35-37 6/7 wk (median risk), can individualize TSB levels for exchange based on actual gestational age.

Figure 3: A) Nomogram of risk of neonatal hyperbilirubinemia and level that deserve photo therapy; B) nomogram of level of exchange transfusion according to risk factors.^[6]

Table 3: Comparison of the mode of therapy (phototherapy and exchange transfusion for newborns suffered from neonatal hyperbilirubinemia with AAP guidelines for phototherapy and exchange transfusion.

Mode of therapy	Total	Met AAP Criteria	Percentage	Not met AAP criteria	Percentage
Phototherapy	426	205	48.1%	221	51.9%
Exchange transfusion	22	17	77.3%	5	22.7%

AAP=American Academy of Pediatrics.

Of 426 received phototherapy, 48.1% (n=205) newborns met AAP criteria of phototherapy. Kappa test showed "0" which mean no agreement beyond chance since all patients received phototherapy. Of the 22 newborns underwent exchange transfusion, 17 (77.3%) were met AAP criteria of exchange transfusion (Table 3, Figure 3). Kappa test was 0.87 indicating there is acceptable level of agreement of the current practice with the AAP guidelines for exchange transfusion in the management of neonatal hyperbilirubinemia.

For newborns who met the AAP criteria of phototherapy, newborns with peak TSB level above 20 were at higher risk of hyperbilirubinemia that needed phototherapy (AOR 29.20, 95% CI 6.90-123.62). Newborns with Rh incompatibility were at a three times risk of hyperbilirubinemia (AOR 3.49, 95% CI 1.76-6.92) and those with ABO incompatibility were at twice risk of hyperbilirubinemia (AOR 2.37, 95% CI 1.39-4.04) that

needed phototherapy according to the AAP criteria of phototherapy. (Table 4).

Newborns with Rh incompatibility were at a six times risk of hyperbilirubinemia (AOR 6.16 95% CI 1.52-25.06) that required exchange transfusion (Table 5) while had a 16 times risk of hyperbilirubinemia (AOR 16.10, 95% CI 2.52-102.95) that required exchange transfusion according to the AAP criteria of exchange transfusion (Table 6). Newborns with ABO incompatibility were at a six times risk of hyperbilirubinemia (AOR 6.02 (0.97-37.24)) that required exchange transfusion according to the AAP criteria of exchange transfusion (Table 6).

Table 4: Univariable and multivariable analysis of the predictors for newborns who met AAP criteria for phototherapy.

Characteristic	Total	N	OR (95% CI)	p-value	AOR (95% CI)	p-value
<i>Age at admission</i>						
>5 days	171	78	1.00			
2-5 days	228	110	1.11 (0.75-1.65)	0.60		
≤1 day	27	17	2.03 (0.88-4.68)	0.10	-----	-----
<i>Gender</i>						
Female	174	88	1.00			
Male	252	117	0.85 (0.58-1.25)	0.40	-----	-----
<i>Residency</i>						
Al-Falluja	236	122	1.00			
Villages	190	83	0.73 (0.49-1.06)	0.10	-----	-----
<i>Sepsis</i>						
No	418	197	1.00			
Yes	8	8	0.47 (0.43-0.52)	0.003	-----	-----
<i>Weight</i>						
≥2500 gm	297	138	1.00			
1500-2499 gm	126	64	1.19 (0.78-1.81)	0.42	-----	-----
<1500 gm	3	3	Inestimable			
<i>Peak TSB level</i>						
<20 mg/dl	373	154	1.00		1.00	
20-24.9 mg/dl	46	44	31.29 (7.47-130.99)	<0.001	29.20 (6.90-123.62)	<0.001
≥25 mg/dl	7	7	Inestimable			
<i>Peak PCV level</i>						
≥35	425	204	1.00			
<35	1	1	0.48 (0.44-0.53)	0.30	-----	-----
<i>ABO incompatibility</i>						
No	324	134	1.00		1.00	
Yes	102	71	3.25 (2.02-5.23)	<0.001	2.37 (1.39-4.04)	0.002
<i>RH incompatibility</i>						
No	363	156	1.00		1.00	
Yes	63	49	4.64 (2.48-8.71)	<0.001	3.49 (1.76-6.92)	<0.001
<i>ABO & RH incompatibility</i>						
No	396	182	1.00			
Yes	30	23	3.86 (1.62-9.21)	0.001	-----	-----

AOR=adjusted odds ratio; CI= confidence interval; OR=odds ratio, PCV=packed cell volume; TSB=total serum bilirubin.

Table 5: Univariable and multivariable analysis of the predictors for newborns treated with exchange transfusion.

Characteristic	Total	N	OR (95% CI)	p-value	AOR (95% CI)	p-value
<i>Age at admission</i>						
>5 days	171	7	1.00			
2-5 days	228	14	1.53 (0.61-3.88)	0.37		
≤1 day	27	1	0.90 (0.11-7.63)	0.92	-----	-----
<i>Gender</i>						
Female	174	9	1.00			
Male	252	13	1.00 (0.42-2.39)	1.00	-----	-----
<i>Residency</i>						
Al-Falluja	236	14	1.00			
Villages	190	8	0.70 (0.29-1.70)	0.43	-----	-----
<i>Sepsis</i>						
No	418	19	1.00			
Yes	8	3	12.60 (2.80-65.67)	<0.001	-----	-----
<i>Weight</i>						
≥2500 gm	297	13	1.00			
1500-2499 gm	126	7	1.29 (0.50-3.30)	0.60	-----	-----
<1500 gm	3	2	43.69 (3.72-513.45)	0.003	-----	-----

<i>Peak TSB level</i>						
<20 mg/dl	373	3	1.00			
20-24.9 mg/dl	46	13	48.59 (13.18-179.15)	<0.001	-----	-----
≥25 mg/dl	7	6	740.00 (66.96-8178.53)	<0.001	-----	-----
<i>Peak PCV level</i>						
≥35	425	21	1.00			
<35	1	1	0.50 (0.03-0.08)	<0.001	-----	-----
<i>ABO incompatibility</i>						
No	324	13	1.00			
Yes	102	9	2.32 (0.96-5.59)	0.06	-----	-----
<i>RH incompatibility</i>						
No	363	13	1.00		1.00	
Yes	63	9	4.49 (1.83-11.00)	<0.001	6.16 (1.52-25.06)	0.01
<i>ABO & RH incompatibility</i>						
No	396	21	1.00			
Yes	30	1	0.62 (0.08-4.74)	0.64	-----	-----

AOR=adjusted odds ratio; CI= confidence interval; OR=odds ratio, PCV=packed cell volume; TSB=total serum bilirubin.

Table 6: Univariable and multivariable analysis of the predictors for newborns who met AAP criteria for exchange transfusion.

Characteristic	Total	N	OR (95% CI)	p-value	AOR (95% CI)	p-value
<i>Age at admission</i>						
>5 days	171	5	1.00			
2-5 days	228	11	1.68 (0.57-4.94)	0.34		
≤1 day	27	1	1.28 (0.14-11.37)	0.92	-----	-----
<i>Gender</i>						
Female	174	6	1.00			
Male	252	11	1.28 (0.46-3.52)	0.64	-----	-----
<i>Residency</i>						
Al-Fallujah	236	11	1.00			
Villages	190	6	0.67 (0.24-1.84)	0.43	-----	-----
<i>Sepsis</i>						
No	418	15	1.00			
Yes	8	2	8.96 (1.67-48.11)	0.002	-----	-----
<i>Weight</i>						
≥2500 g	297	13	1.00			
1500-2499 g	126	7	1.44 (0.51-4.04)	0.49		
<1500 g	3	2	14.35 (1.20-171.68)	0.04	-----	-----
<i>Peak TSB level</i>						
<20 mg/dl	373	1	1.00			
20-24.9 mg/dl	46	11	116.91 (14.66-932.32)	<0.001	-----	-----
≥25 mg/dl	7	5	930.00 (72.07-12000.27)	<0.001	-----	-----
<i>Peak PCV level</i>						
≥35	425	16	1.00			
<35	1	1	0.04 (0.02-0.06)	<0.001	-----	-----
<i>ABO incompatibility</i>						
No	324	8	1.00		1.00	
Yes	102	9	3.82 (1.44-10.19)	0.004	6.02 (0.97-37.24)	0.05
<i>RH incompatibility</i>						
No	363	9	1.00		1.00	
Yes	63	8	5.72 (2.12-15.46)	<0.001	16.10 (2.52-102.95)	0.003
<i>ABO & RH incompatibility</i>						
No	396	16	1.00			
Yes	30	1	0.82 (0.11-6.40)	0.85	-----	-----

AOR=adjusted odds ratio; CI= confidence interval; OR=odds ratio, PCV=packed cell volume; TSB=total serum bilirubin.

DISCUSSION

Main finding

Our study findings showed the current practice in the management of neonatal hyperbilirubinemia is consistent with the AAP guidelines recommendation for exchange transfusion but not for phototherapy. Out of 22 newborns underwent exchange transfusion, only 5 newborns (22.7%) did not meet the AAP criteria for exchange transfusion with kappa test of 0.87 indicating acceptable level of agreement between the doctors' decisions and the AAP guidelines criteria for exchange transfusion. While half of newborns received phototherapy did not meet the AAP criteria for phototherapy. Rh and ABO incompatibilities were the main risk factors of severe hyperbilirubinemia that treated exchange transfusion and complementary phototherapy (AOR 16.10, 95% CI 2.52-102.95, AOR 6.02 (0.97-37.24) respectively). Peak TSB level above 20 mg/dl was a significant risk of neonatal hyperbilirubinemia who needed phototherapy (AOR 29.20 (6.90-123.62)).

Strength and limitations

The main strength of the study is that included all newborns admitted to our hospital during 2017 which minimizes the risk of selection bias. A study sample of more than 400 newborns provided good power for estimation of the clinical risk factors. Our study is the first study that assess the current practice in the management of neonatal hyperbilirubinemia in Iraq with the AAP guidelines. We did not discover similar study in literature search.

The main limitation of study is inadequate provision of the information due to the shortage of medications such as IVIG and advanced equipments in hospital's laboratory that limited our estimation of other established risk factors such as G6PD enzyme deficiency, direct comb's test level, thyroid function test and others. Other limitation is that we have no chance to assess and add further potential risk factor since the data is retrospectively collected.

Interpretations

The incidence of the neonatal hyperbilirubinemia (419 per 10,000 live births) in Al-Fallujah city is three folds higher than the incidence of east Mediterranean reported by the Slusher et al 2017 systematic review (165 per 10,000 live births).^[11] However, the incidence according to AAP criteria of phototherapy was 201 per 10,000 live births which is close to the current evidence. Hameed et al 2011 study has also reported high incidence of neonatal hyperbilirubinemia 322 per 10,000 live births which is still twice the average of east Mediterranean.^[11] Compare our study results to the results reported by Kassawnah et al 2013 study in Jordan,^[12] the incidence is one fifth to that reported in our study estimate (419 vs 76 per 10,000 live births). These high figures and gap difference highlighted the need to review the current Iraqi practice in management of neonatal hyperbilirubinemia to minimize the unnecessary

admissions. Given the side effects arise from the use of the phototherapy and exchange transfusion, improper cost effectiveness and limited hospital resources, it is valuable to establish a simple tool to identify the newborns at higher risk of neonatal hyperbilirubinemia for proper managements.

The incidence of exchange transfusion in our study is 21 per 10,000 live births which slightly higher to the incidence reported by Slusher et al 2017 (17.8 per 10,000 live births), however, when plotted the values of those newborns in AAP criteria for exchange transfusion it yields similar results (17 per 10,000 live births).^[11] In general, the experience of the decision making for exchange transfusion in the current practice is acceptable (kappa test 0.87). Only 22.7% of newborn underwent unnecessary exchange transfusion in our study while 50.5% of newborns underwent unnecessary exchange transfusion in Jordan's study.^[12]

Unlike the findings from Iraq,^[15] and Jordan,^[12] our study demonstrated that newborns with Rh or ABO incompatibilities were at higher risk of developing severe hyperbilirubinemia that needed exchange transfusion (AOR 16.10, 95% CI 2.52-102.95). Newborns admitted with TSB at or greater than 20 mg/dl were at higher risk of hyperbilirubinemia that required hospital admission for phototherapy and exchange transfusion. The main duration of stay in hospital is 2.3 days (SD 2.0) which is half the period of the hospital stay reported in Jordan's study.^[12] This difference might be due to the unnecessary admission and rapid discharge. Most of the unnecessary admission is belong to the extra precaution of the doctors who may aware from development of unexpected complications (for prophylactic measures) and due to shortage in the resources to confirm the diagnosis. In addition, many parents especially young age and those with first or precious baby had lack of knowledge and experience in handling the newborn and in identification the real sick one.

Our study result had estimated that a newborn with clinical sepsis were independently at nine times increased risk of neonatal hyperbilirubinemia than no sepsis (OR 8.96 (1.67-48.11)). Therefore, any new born with hyperbilirubinemia and abnormal clinical manifestations should be assessed to rule out sepsis. Most the independent risk factors associated with those underwent exchange transfusion in our study were similar to risk factors associated with newborns with hyperbilirubinemia met the AAP criteria of exchange transfusion.

Translation of our study findings into clinical practice demonstrated that there is a great need to increase the doctors' alertness regarding proper management and hospital admission. The findings also highlighted the need to establish a national guideline for the management of neonatal hyperbilirubinemia in Iraq depending on the local and national published evidences.

Provision of the advanced medical equipments and medications are necessary. A nation-wide health education program regarding the risk of neonatal hyperbilirubinemia for different stakeholders including nurses, midwives, parents and others healthcare workers, is an important preventive measure.

The results also highlighted the need to conduct future researches including population-based studies to provide more evidences and to inform the national guidelines. Furthermore, it is essential to establish a preventive strategy through development a risk prediction tool to identify the newborns at increased risk of severe hyperbilirubinemia for proper management to prevent complications.

CONCLUSIONS

Neonatal hyperbilirubinemia is highly incident in Iraq due to unnecessary hospital admissions. The current practice in the management of neonatal hyperbilirubinemia is consistent with the AAP guidelines recommendation for exchange transfusion but not for phototherapy. Newborns with Rh or ABO incompatibilities are at higher risk of severe hyperbilirubinemia and exchange transfusion. Further researches and development are needed.

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Author contributions

BA, BZ and ZA contributed in development of the research questions. BA led data collection and contributed in the writing and interpretation of the results. BZ contributed in the data analysis, writing and interpretation of the results. ZA led data analysis and contributed in the writing and interpretation of the results.

Disclosure of interest

The authors report no disclosure of interest.

Ethics approval

The study was approved by Al-Fallujah teaching hospital for maternity and childhood ethics committee.

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