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Hyperbilirubinemia among Newborns Admitted to Sabratha Teaching Hospital: A Cross-Sectional Study

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Abstract:

Background: Hyperbilirubinemia is a condition in which excess bilirubin is in the blood. Bilirubin is a non-polar endogenous by-product of heme catabolism with 85% from normal senescent erythrocyte broken down and 15% from ineffective erythropoiesis or turnover of non-hemoglobin hem proteins. In newborns, hyperbilirubinemia becomes clinically apparent as jaundice when total serum bilirubin concentration gets ⩾5mg/dL in contrast to adults at ⩾2mg/dL. Accumulation of bilirubin in the skin and mucous membrane causes yellow discoloration of the skin and sclera of the eye and causes cephalocaudally in advancements. Materials and Methods: this hospital-based cross-sectional study aimed to explore the percent of the bilirubinemia among the newborns in Sabratha and to detect the highest level of bilirubin that has been recorded among newborns. A total of 80 neonates with their mothers were included and conveniently selected. Data was collected by reviewing neonates' medical records using special lists and statistically analysed using SPSS version 23. Results: Mean value of total bilirubin for male babies at first day of admission was 13.17±0.62 mg/dl. It is high as compared with the normal values of total bilirubin in neonates. For female neonates the mean value of total bilirubin at first day of admission was 13.11±0.64 mg/dl. That mean there was no big different between both values for males and females. There was no difference between values at first and last day of admission in males (0.51±0.04 mg/dl and 0.69±0.06 mg/dl). There was mildly high correlation between haemoglobin concentration and red blood cells count. Conclusion: The prevention and management of hyperblirubinemia has been revolutionized in the last century, reducing the previously substantial degree of morbidity and mortality of neonates to a minimum. The current study indicated the high prevalence of hyperbilirubinemia among neonates admitted to Sabratha Teaching Hospital (STH). Of course, different cause might be implicated in this case as it known clinically. As a recommendation, it is mandatory to screen, treat, and manage hyperbilirubinemic neonates and its associated risk factors in neonates admitted to STH.

Keywords: Bilirubinemia, Total bilirubin, Neonates, anemia, Sabratha Teaching Hospital

ارتفاع بيليروبين الدم لدى الأطفال حديثي الولادة الذين تم دخولهم مستشفى صبراتة التعليمي: دراسة مقطعية

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الملخص:

فرط بيليروبين الدم هو حالة يكون فيها البيليروبين الزائد في الدم. البيليروبين هو منتج ثانوي داخلي غير قطبي لتقويض الهيم، حيث يتم تكسير 85% من كريات الدم الحمراء الطبيعية الهرمة و15% من تكون الكريات الحمر غير الفعالة أو دوران بروتينات الهيم غير الهيموجلوبين. عند الأطفال حديثي الولادة، يصبح فرط بيليروبين الدم واضحًا سريريًا على شكل يرقان عندما يصل إجمالي تركيز البيليروبين في المصل إلى -5 ملجم / ديسيلتر على عكس البالغين عند -2 ملجم / ديسيلتر. يؤدي تراكم البيليروبين في الجلد والأغشية المخاطية إلى تغير لون الجلد وصلبة العين إلى اللون الأصفر ويسبب التهابًا رأسيًا كاوديًا في المراحل المتقدمة. المواد والطرق: تهدف هذه الدراسة المقطعية في المستشفى إلى استكشاف نسبة البيليروبين في الدم بين الأطفال حديثي الولادة في صبراتة والكشف عن أعلى مستوى من البيليروبين تم تسجيله بين الأطفال حديثي الولادة. تم تضمين ما مجموعه 80 حديثي الولادة مع أمهاتهم واختيارهم بشكل ملائم. تم جمع البيانات من خلال مراجعة السجلات الطبية لحديثي الولادة باستخدام حزمة التحليل الاحصائي الاصدار الخاص. النتائج: متوسط قيمة البيليروبين الإجمالي للأطفال الذكور في اليوم الأول من دخول المستشفى كان 13.17 ± 0.62 ملغم / ديسيلتر. وهو مرتفع مقارنة بالقيم الطبيعية للبيليروبين الكلي عند الأطفال حديثي الولادة. بالنسبة للمواليد الإناث، كان متوسط قيمة البيليروبين الكلي في اليوم الأول من دخول المستشفى 13.11 ± 0.64 ملغم / ديسيلتر. وهذا يعني أنه لم يكن هناك اختلاف كبير بين القيمتين بالنسبة للذكور والإناث. لم يكن هناك فرق بين القيم في اليوم الأول والأخير من القبول لدى الذكور (0.51 ± 0.04 ملغم / ديسيلتر و 0.69 ± 0.06 ملغم / ديسيلتر). كان هناك ارتباط مرتفع إلى حد ما بين تركيز الهيموجلوبين وعدد خلايا الدم الحمراء. الاستنتاج: لقد حدثت ثورة في الوقاية من فرط بليروبين الدم وإدارته في القرن الماضي، مما أدى إلى تقليل الدرجة الكبيرة سابقًا من المراضة والوفيات بين الولدان إلى الحد الأدنى. أشارت الدراسة الحالية إلى ارتفاع معدل انتشار فرط بيليروبين الدم بين الأطفال حديثي الولادة الذين تم إدخالهم إلى مستشفى صبراتة التعليمي .

الكلمات المفتاحية: البليروبين في الدم، البليروبين الكُلي، حديثي الولادة، فقر الدم، مستشفى صبراتة التعليمي

1. Introduction

Hyperbilirubinemia is a condition in which excess bilirubin is in the blood. Bilirubin is a non-polar endogenous by-product of heme catabolism with 85% from normal senescent erythrocyte broken down and 15% from ineffective erythropoiesis or turnover of non-hemoglobin hem proteins.[1]

In newborns, hyperbilirubinemia becomes clinically apparent as jaundice when total serum bilirubin concentration gets ⩾5mg/dL in contrast to adults at ⩾2mg/dL. Accumulation of bilirubin in the skin and mucous membrane causes yellow discoloration of the skin and sclera of the eye and causes cephalocaudally in advancements. [2]

As a history, for centuries, neonatal jaundice (icterus neonatorum) has been observed in newborns. As early as 1724, Juncker, in the Conspectus Medicinae Theoreticopraticae, began distinguishing between “true jaundice” and “the icteric tinge which may be observed in infants, immediately after birth.” In 1875, Orth noticed during autopsies the presence of bilirubin in the basal ganglia of infants who had severe jaundice, which was labeled kernicterus by Schmorl in 1903. [3]

In 1958, however, a nurse in the nursery of the General Hospital in Rothford, Essex, Great Britain, reported “an apparent fading away of the yellow pigmentation in the skin of the jaundiced babies when they had been a short time in sunlight. [4]

Icterus neonatorum occurs in approximately two thirds of all newborns in the first postnatal week. Jaundice results from bilirubin deposition in the skin and mucous membranes. For most newborns, such deposition is of little consequence, but the potential remains for kernicterus from high bilirubin concentrations or lower bilirubin concentrations in preterm infants. [5] Although rare, kernicterus is a preventable cause of cerebral palsy.

Hyperbilirubinemia was treated aggressively in the 1950s to 1970s because of a high rate of Rh hemolytic disease and kernicterus. However, data from the 1980s and 1990s showed that pediatricians may have been too aggressive in their approach, almost making kernicterus a disease of the past.

Pediatricians subsequently became less aggressive, discharging newborns earlier from nurseries before bilirubin concentrations peaked. These factors helped lead to an increase in kernicterus in the 1990s. [6] Because of these events, an American Academy of Pediatrics (AAP) Subcommittee on Hyperbilirubinemia established guidelines for the approach to neonatal jaundice. [7]

As we will discuss later, several types of Bilirubinemia have been reported in neonates including physiological jaundice, pathological jaundice, jaundice due to breastfeeding or breast milk and hemolytic jaundice including three subtypes due to Rh factor incompatibility, ABO blood group incompatibility and Jaundice associated with Glucose-6-phosphate dehydrogenase (G6PD) deficiency. [8]

2. Aims of the study

The aim of the current study was to explore the percent of the bilirubinemia among the newborns, detect the highest level of bilirubin that has been recorded among newborns during the last two years in the pediatric department of Sabratha Teaching Hospital (STH),and evaluate the bilirubinemia management plan followed in STH.

3. Materials and Methods

3.1. Study design

Hospital-based cross-sectional study was conducted at Sabratha Teaching Hospital (STH) from 2022-2024.

3.2. Study population

A total of 80 neonates with their mothers were included and conveniently selected. Data was collected by reviewing neonates' medical records using special lists. Additionally, 12 neonate investigation data were registered from the registration office of the pediatric department including some data related to mothers of the same neonates (blood groups of both neonates and mothers) to know the percent of the compatibility of blood groups between them.

3.3. Limitations

One of the most limitations of this study was the number of data. That means we could not find more investigations of more number of newborns that can be included in this study. It was difficult also, that to find some special data related to mothers and history of families.

3.4. Data collection

The research team of the students has visited the paediatric department of Sabratha Teaching Hospital (STH) in order to collect all data related to the title of the study (Hyperbilirubinemia of Newborns in West Region of Libya, Sabratha City is A model). Under the supervision of the paediatrics physicians. All data have been collected and recorded in special tables and then been filled in EXCEL file to be analysed statistically.

3.5. Data quality assurance

All quality assurance components were applied in course of these studies. To increase the reliability of data, two data collectors were assigned by team leaders of neonatal nurses based on their previous experience in data collection and language skills. Besides training on the data collection procedures was given to the students.

3.6. Statistical analysis

All data were arranged and entered into Excel file (Microsoft office version 2013) and then transferred into SPSS version 23 for statistical analysis. Different statistical measurements have been applied on the data such as mean value, standard deviation P value and correlation between some important parameters. All results been represented in tables and figures to clarify different measurements done.

4. Results and Discussion

In newborns, serum bilirubin universally exceeds this level for physiological reasons during the transitional period after birth. Jaundice becomes evident when the total serum bilirubin level reaches 5 mg/dL (86 mmol/L). [9]

In a more recent study, neonatal jaundice affected 84% of neonates born at at least 35 weeks of gestation. [9] Jaundice usually begins on the face and progresses in a cephalocaudate fashion, for unknown reasons.

The total bilirubin level roughly correlates with progression of jaundice (face, 4–8 mg/dL [68–137 mmol/L]; upper trunk, 5–12 mg/dL [86–205 mmol/L]; lower trunk, 8–16 mg/dL [137–274 mmol/L]; soles of the feet, >15 mg/dL [>257 mmol/L]). [9] It is important to understand the metabolism of bilirubin to be able to identify the factors that lead to hyperbilirubinemia in the newborns.

4.1. Average of total, direct and indirect bilirubin

After data statistical analysis of 80 neonates including the values of total bilirubin, direct bilirubin, indirect bilirubin, red blood cells, haemoglobin, white blood cells, and platelets for males and females that have been investigated during the first week after delivery and at the last day before discharge, table 1 shows different results of statistical analysis of all parameters compared together.

Table .1: Mean values (M), standard deviation (SD) and significance of difference (P value).

GROUPS	T.B	D.B	IN.B	RBC	HGB	WBC	PLT
Baby Male In	13.17^{a} ±0.62	0.51^{a} ±0.04	11.86^{ab} ±0.60	6.26×10^{7a} $\pm 2.11 \times 10^{7}$	15.96^{bc} ±0.37	3.98×10^{7a} $\pm 1.91 \times 10^{7}$	1.90×10^{7a} $\pm 9.72 \times 10^{6}$
Baby Male Out	12.80^{a} ±0.31	0.69^{a} ±0.06	11.94^{ab} ±0.39	1.78×10^{7a} $\pm 1.41 \times 10^{7}$	14.34^{a} ±0.52	1.18×10^{4a} $\pm 7.50 \times 10^{2}$	2.89×10^{5a} $\pm 2.54 \times 10^{4}$
Baby Female In	13.11^{a} ±0.64	0.66^{a} ±0.08	12.91^{b} ±0.69	3.41×10^{7a} $\pm 2.10 \times 10^{7}$	16.85^{c} ±0.45	3.96×10^{7a} $\pm 2.86 \times 10^{7}$	3.45×10^{7a} $\pm 2.09 \times 10^{7}$
Baby Female Out	11.80^{a} ±0.46	0.89^{b} ±0.09	10.68^{a} ±0.46	2.29×10^{7a} $\pm 1.88 \times 10^{7}$	15.34^{ab} ±0.56	4.57×10^{7a} $\pm 4.56 \times 10^{7}$	5.26×10^{6a} $\pm 4.99 \times 10^{6}$

*Values are means of replicates ± standard deviation, $^{a-c}$ means within a column with different letters are significantly different ($P < 0.05$)

It is clear from table.1 that mean value of total bilirubin for male babies at first day of admission was 13.17±0.62 mg/dl. It is high as compared with the normal values of total bilirubin in neonates as mentioned above. On the other hand, for female neonates the mean value of total bilirubin at first day of admission was 13.11±0.64 mg/dl. That mean there was no big different between both values for males and females whereas the values of total bilirubin at the last day for both genders were a little pit decreased into 12.80±0.31 mg/dl and 11.80±0.46 mg/dl for males and females respectively.

Conversely, with regard to direct bilirubin, there was no difference between values at first and last day of admission in males (0.51±0.04 mg/dl and 0.69±0.06 mg/dl). In case of females, there was relatively difference between direct bilirubin values at first and last day of admission (0.66±0.66 mg/dl and 0.89±0.09 mg/dl).

Table .2: Average normal range of bilirubin for neonates [10].

Reference interval bilirubin – examples		
	µmol/L	mg/dL
Adult:	0–34	0–2.0
3–5 days (fb):	68–137	4.0–8.0
3–5 days (pm):	171–240	10.0–14
1–2 days (fb):	103–171	6.0–10
1–2 days (pm):	103–205	6.0–12
0–1 day (fb):	34–103	2.0–6.0
0–1day (pm):	17–137	1.0–8.0
Cord blood (fb):	<34	<2.0
Cord blood (pm):	<34	<2.0

4.2. Mean of RBC count

With regard to red blood cell count, there was clear and significant difference between RBC count at first and last day of admission for both males and females. (Table .1) shows that mean of RBC count was $6.26 \times 10^7 \pm 2.11 \times 10^7$/ cumm in males at first day of admission whereas at the last day of admission RBC count was decreased to $1.78 \times 10^7 \pm 1.41 \times 10^7$ /cumm. With regard to females the situation was a little pit different. While RBC count at first day was $3.41 \times 107 \pm 2.10 \times 10^7$ /cumm, RBC count at last day of admission has decreased to $2.29 \times 107 \pm 1.88 \times 10^7$ /cumm.

According to some studies, in general terms, anemia results from a decrease in the hemoglobin content, while jaundice results from an increase in the bilirubin content. Both of them have a significant impact on public health worldwide, with anemia being more prevalent among women of childbearing age, and janudice more common among neonates due their underdeveloped liver. In this case, there may or may not be normal hemoglobin concentration in the blood. According to Chang et al. [11], the depletion of RBCs can result from a number of pathologies and risky situations. The majority of the reported jaundice cases are for neonates.

One of the main reasons why this medical condition is more prevalent among neonates is that they produce more red blood cells than adults. Since a neonate's liver is not fully developed, it may not be completely successful in removing adequate amounts of bilirubin from the body. [12]

The common types of neonatal jaundice include [12]:

• "normal" jaundice - characterized by the slow processing of bilirubin by the neonate's liver;

• Prematurity jaundice - in premature neonates, jaundice occurs more frequently since their liver is even less developed; and

• breast milk jaundice/blood group incompatibility jaundice - characterized by a sudden buildup of bilirubin in the neonate's blood either due to substances produced in the breast milk or due to a different blood type of the mother.

The bilirubin contents for neonates (as shown in Table 4) are different from that of adults. [13] In fact, it differs even from premature to full term neonates. [14]

4.3. Haemoglobin concentration

Ebbesen *et al.* [15] stated that it appears that the photo isomers of bilirubin are predominantly formed in the plasma, and the rate of formation is affected by the hemoglobin concentration. [15] In the present study, we investigated whether the efficiency of phototherapy, expressed as the decline in the total serum bilirubin concentration (TB), is dependent on the concentration of hemoglobin. We hypothesized that the efficacy of phototherapy will decrease with increasing hemoglobin concentrations.

As shown in table 1, mean haemoglobin concentration in male neonates at the first day of admission was 15.96 ±0.37 g/dl and after phototherapy at the last day of admission has decreased to 14.34 ±0.52 g/dl. With regard to females, the same decrease has been observed; 16.85 ±0.45 g/dl and 15.34 ±0.56 at first and last day of admission respectively.

Physiologically, the hemoglobin in the erythrocytes will absorb light, which implies that a fraction of the light will not reach the bilirubin molecules, i.e., hemoglobin in the erythrocytes will compete with the bilirubin molecules and thereby influence the efficacy of phototherapy. This has also been investigated by measuring the photo-bilirubins.

The formation of Z,E-bilirubin is reversible, and Z,E-bilirubin accumulates rapidly in plasma at commonly used levels of irradiance because of a fast formation and a slow excreting rate. Within a few hours of phototherapy, the ratio of Z,E-bilirubin to Z,Z-bilirubin reaches a plateau, which means that a photo-equilibrium occurs between these two substances. [16]

Similarly, the platelets count has increased in both males and females after therapy after comparison between results at first day and last day of admission (Table 1).

4.4. Incompatibility according to ABO groups between neonates and mothers

The incidence of the incompatibility of the ABO blood groups of the mother and fetus, when the mother has the blood group O and the newborn has the A or B blood group, is 15-20% of all pregnancies. [17] Babies with O-blood group mothers should be closely checked for and discharged after 72 h.

Therapeutically, only O-blood group should be used for exchange transfusion in newborns with ABO incompatibility. The best choice would be O group (Rh compatible) packed cells which are suspended in O group/AB plasma whole blood (Rh compatible with baby). [17]

In the current study, table 3 show the total number of neonates who were compatible in blood groups (ABO system) with their mothers.

According to the results shown in table 3, from the total number of 48 male neonates, it is clear that babies with blood group A+ve were 11, 3 of them are compatible and 8 are un-compatible, 3 B-ve, 1 are compatible and 2 are un-compatible, 9 B-ve, with un-compatible blood groups with their mothers, 3 O-ve, 2 compatible and 1 un-compatible and from 17 O+ve, 7 are compatible and 10 un-compatible blood groups with their mothers.

Table .3: Total number of neonates who were compatible in blood groups (ABO system) with their mothers.

Baby Groups	Baby Blood ABO/Rh	Total	Compatible	Not Compatible	Total
Baby Male	A^+	11	3	8	48
	B^-	3	1	2	
	B^+	9	0	9	
	O^-	3	2	1	
	O^+	17	7	10	
	Not Available	5		5	
Baby Female	A^-	1	0	1	32
	A^+	12	3	9	
	B^-	1	0	1	
	B^+	6	0	6	
	O^-	3	0	3	
	O^+	9	3	6	
	Not Available	0			
Total			19	61	80

On the other hand, the results of 32 female neonates were in different situation as following: one with un-compatible A-ve blood group, 12 A+ve, 3 of them are compatible and 9 are un-compatible, 1 with B-ve blood group are un-compatible, 6 B+ve group are un-compatible, 3 O-ve un-compatible and from 9 O+ve blood groups, 3 of them are compatible and others are un-compatible with their mothers.

According to the results in table 3, it can be observed that among male neonates, (O+ve) blood group represented the highest percent of blood groups among neonates in this study with a percent of 35%, followed by (A+ve) blood group 23% and 19% belonging to B+ve, 11% of unknown blood groups and 6% of (O-ve) and (B-ve) blood groups.

Similarly, the highest percent of blood groups among female neonates are A+ve groups with a percent of 38%, followed by O+ve with a percent of 28%, then B+ve by 19% and so on.

Scientifically, only O-ve blood group should be used for exchange transfusion in newborns with ABO incompatibility. The best choice would be O group (Rh compatible) packed cells which are suspended in O group/AB plasma whole blood (Rh compatible with baby). In case of the Cross-matched with baby's blood group blood volume used or double volume exchange should be kept in mind. Partial exchange is done at birth in Rh hemolytic disease: 50-ml/ kg of packed cells. [18]

4.5. Rhesus Antigen D Hemolytic Disease of the Fetus and Newborn (RhD-HDFN)

Before 1945, before the introduction of effective prevention and management strategies, the perinatal mortality in high-income white countries was approximately 4000 per 100,000 births, and approximately 10% of this estimate was associated with Rh hemolytic disease, which equates to approximately 0.4% of births.

Approximately 1% of pregnancies were affected by RhD-HDFN, and an estimated 40% to 50% of these pregnancies resulted in stillbirth or neonatal death. [19] The introduction in particular of

exchange transfusion as well of prevention of RhD sensitization has dramatically reduced this incidence and mortality. [20]

The results of this study are in agreement with the results of other studies about the effect of un-compatible blood groups between neonates and their mothers especially in some cases of blood groups such as O-ve group.

4.6. ABO Hemolytic Disease of the Fetus and Newborn (ABO-HDFN)

ABO HDFN is the most common form of HDFN and the leading cause of neonatal jaundice.41 It almost entirely occurs in type O blood group mothers who have a baby that is type A, B, or AB blood group; however, it can occur in rare circumstances with type A or B group mothers. [21]

Consequential anemia and hydrops fetalis are very rare; however, neonatal hyperbilirubinemia is common. ABO incompatibility occurs in 12% to 15% of pregnancies, with evidence of sensitization in approximately 3% to 4% of these pregnancies, as shown by a positive direct Coombs test; however, less than 1% have symptomatic hemolysis. [22]

Table .4: Correlation between T.B, HGB, RBC, sex and Healthy status

	T.B	HGB	Healthy status	sex	RB
T.B	1.000	-0.099	-0.099	-0.077	-0.(
HGB	-0.099	1.000	-.234**	0.138	.67
Healthy status	-0.099	-.234**	1.000	0.000	-.2
sex	-0.077	0.138	0.000	1.000	0.0
RBC	-0.031	.679**	-.242**	0.016	1.0

**. Correlation is significant (P< 0.01)

*. Correlation is significant (P< 0.05)

The results in Table .4 shows another important observations about the situation of hyperbilirubinemia among neonates during the first week after delivery. There was mildly high correlation between haemoglobin concentration and red blood cells count. That was a natural result due to the decrease in RBCs count at the last day of admission.

The r. value was 0.679 in a positive side with significant value (P value) of less than 0.01 as mentioned in the table. Additionally, there was a correlation between the healthy status of all neonates and the value of total bilirubin as it is clear from table 3.

4.7. Special investigations for 12 of the most hyperbilirubinemic neonates chosen in the current study

In order to make sure that our investigations were accurate and to confirm the results obtained in the current study, the research team have chosen 12 neonates randomly among 80 neonates participated in the study to do more laboratory investigations such as total bilirubin, in direct bilirubin and haemoglobin due to the reason that the mentioned results have confirmed the clear correlation between some parameters investigated for the total sample included in this study during the period of admission.

As shown in table (4), the values of total bilirubin for all neonates were high at the first day of admission. After the exact period of management, all values of total bilirubin were decreased to the normal values at the last day on admission.

Table .5: comparisons between total bilirubin values among 12 hyperbilirubinemic neonates.

Cases	T.B	D.B	in.B	RBC	HGb	WBC	PLt
Baby 1	17.12	1.59	19.20	2.75+12	10.27	1.20+10	4.22+11
	1.32	0.15	0.60	2.61+11	0.68	2.91+08	1.74+10
Baby 2	14.71	0.71	13.00	5.15+06	17.80	4.90+03	1.83+05
	1.92	0.14	0.50	0.00+00	0.00	0.00+00	0.00+00
Baby 3	15.53	0.83	14.73	3.84+06	13.98	9.88+03	3.79+05
	0.94	0.20	0.94	1.71+05	0.77	9.78+02	2.10+04
Baby 4	11.97	0.43	11.53	4.72+04	16.60	1.37+04	3.06+04
	0.72	0.07	0.69	0.00+00	0.00	0.00+00	0.00+00
Baby 6	13.59	0.32	13.25	3.16+06	11.00	1.20+04	3.86+05
	2.20	0.10	2.23	5.23+05	1.94	1.63+03	1.65+05
Baby 7	14.40	0.53	10.79	4.44+06	15.48	1.84+04	3.18+05
	1.02	0.06	0.64	1.96+05	0.58	8.68+02	8.46+04
Baby 8	18.02	1.56	14.67	2.00+12	13.33	1.01+10	9.72+10
	1.79	0.32	1.31	8.97+11	1.06	5.01+09	4.83+10
Baby 9	13.93	0.65	13.27	4.11+06	13.98	1.62+04	3.77+05
	1.19	0.18	1.11	9.84+04	0.38	1.74+03	2.45+04
Baby 10	16.02	0.81	16.41	3.07+06	12.18	8.89+03	2.44+05
	2.61	0.20	2.79	2.15+05	0.77	1.26+03	2.14+04
Baby 11	12.92	0.68	12.24	4.38+06	13.70	7.78+03	4.44+05
	1.28	0.28	1.21	1.65+05	0.64	1.29+03	1.24+05
Baby 12	12.50	0.67	11.83	3.59+06	13.97	1.22+04	1.83+05
	0.59	0.23	0.38	1.88+05	0.88	1.02+03	2.20+04

In contrast to the results mentioned above, values of different parameters related to the hyperbilirubinemia were high as shown in table.5. After a period of therapy, all high values were decreased to the normal range.

4.8. Postnatal Treatment (Most effective and urgent procedures)

with regard to the haemolytic naemia, which is the most common cause of hyperbilirubinemia in neonates depending on the severity of the illness at birth and degree of antenatal diagnosis and investigation, babies are born with a broad range of clinical manifestations.

Those with hydrops fetalis unmanaged in the antenatal period are likely to need significant supportive therapy, including resuscitation to manage symptomatic anemia and fluid accumulations such as pleural effusions, as well as underdeveloped organs such as pulmonary hypoplasia.

Blood tests are performed postnatally on potentially affected neonates in sensitized pregnancies. This testing includes blood type, hematocrit and hemoglobin levels, direct antiglobulin test (DAT), and serum bilirubin levels. A positive DAT is not specific for HDFN, and a negative DAT does not exclude HDFN. A positive DAT in the absence of abnormal jaundice has a very low positive predictive value. [23]

Note that some patients only develop late-onset hemolysis, so, if blood work is initially reassuring, the baby still needs monitoring and clinical assessment for several weeks. [67] This requirement is often forgotten and is thus a cause of preventable morbidity in the current medical environment. [24]

Bilirubin level can be assessed by various means; conventionally, this is done with a blood test to assess the serum bilirubin level, but newer technologies have seen the introduction of transcutaneous monitoring. [25]Transcutaneous sampling is considered to be not as precise, but it serves a purpose in reducing the number of invasive blood samples and in predicting mild to moderately increased bilirubin levels. [25]

4.9. Phototherapy

Serum bilirubin concentration can be reduced using phototherapy. Phototherapy uses light of specific wavelengths (450–490 nm). [26] It must be noted that, contrary to some historical teaching and current popular belief, this wavelength is found in natural sunlight, and thus sunlight therapy can be used to treat neonatal jaundice; however, is usually not recommended because of the risk of sunburn. [27]

The wavelength of the light changes the bilirubin into isomers that are water soluble, and thus performs the role of the underproduced UGT.84 The kidneys can then excrete the red blood cell destruction byproducts, and the toxic buildup of bilirubin is reduced. [28]

This is a slow but effective process. Mild complications of this treatment include bronze skin discoloration, skin rashes, and loose stools. [27] It is common to use phototherapy before and after an exchange transfusion to reduce bilirubin levels.

Most neonatal units have internationally standardized nomograms that guide the use of phototherapy depending on the age of the neonate and the risk of neurologic compromise, many of which internationally use the Bhutani nomogram. [26]

Phototherapy can be intensified by increasing the number of lights on the baby, increasing the surface area exposed, and increasing time under the lights. New and novel technologies have been created over the last 30 to 40 years, including biliblankets and bilibeds, which are designed to make phototherapy more practical and effective. [29]

4.10. Exchange transfusion

Exchange transfusion is used for treatment of HDFN when serum bilirubin levels reach a dangerous level oemains labor, time, and resource intensive. However, newer automated techniques have reduced the time and labor involved in specialized treatment centers. Regardless, a high level of expertise is required to perform this specialized procedure. Again, it is rare that ABOn the nomograms, with high risk of neurologic impairment, including kernicterus. Wallerstein [30], introduced the practice of neonatal exchange transfusion in 1946, and this led to a dramatic reduction in mortality associated with HDFN.

The first exchange transfusion was described in the setting of ABO incompatibility and involved replacing the patient's antibody-coated red blood cells with donated red blood cells, as well as removing the high levels of bilirubin. [27]

This procedure r -incompatibility HDFN causes disease severe enough to require such therapy. [27]

5. Conclusions

The prevention and management of hyperblirubinemia has been revolutionized in the last century, reducing the previously substantial degree of morbidity and mortality of neonates to a minimum.

The current study indicated the high prevalence of hyperbilirubinemia among neonates admitted to Sabratha Teaching Hospital (STH). Of course, different cause might be implicated in this case as it known clinically.

Besides that, there are many genetic disorders that are associated with hyperbilirubinemia. In effect, one could say that all genetic disorders lead to hyperbilirubinemia, as all roads lead to Rome. Even in acquired diseases linked with hyperbilirubinemia, such as cephalhematomas or meconium ileus, there may be a genetic abnormality as an underlying cause of the disease

Rapid and accurate screening systems for these genetic disorders should be established for the proper management of neonatal hyperbilirubinemia so that brain damage can be prevented

Currently, infants are being discharged at earlier ages, it is important to consider screening with a TSB before discharge because visual assessment is not always reliable. It is equally important to arrange for follow-up evaluation after discharge, ideally within 48 hours, for additional screening.

Mothers should be educated about feeding to ensure that the infants are receiving adequate caloric intake and monitoring stool and urine output. Weight can be checked at the follow-up visit.

When evaluating bilirubin concentrations, nomograms can be used to guide initiation of phototherapy and exchange transfusions. Guidelines and published nomograms can support clinical judgment and individualize the approach to the infant who has hyperbilirubinemia.

The most important conclusions according the current study were as following:

1) Mean value of total bilirubin for male babies at first day of admission was 13.17±0.62 mg/dl. It is high as compared with the normal values of total bilirubin in neonates.
2) For female neonates the mean value of total bilirubin at first day of admission was 13.11±0.64 mg/dl. That mean there was no big different between both values for males and females.
3) Values of total bilirubin at the last day for both genders were a little pit decreased into 12.80±0.31 mg/dl and 11.80±0.46 mg/dl for males and females respectively.
4) There was no difference between values at first and last day of admission in males (0.51±0.04 mg/dl and 0.69±0.06 mg/dl).

5) In case of females there was relatively difference between direct bilirubin values at first and last day of admission (0.66±0.66 mg/dl and 0.89±0.09 mg/dl).
6) There was clear and significant difference between RBC count at first and last day of admission for both males and females.
7) Mean haemoglobin concentration in male neonates at the first day of admission was 15.96 ±0.37 g/dl and after phototherapy at the last day of admission has decreased to 14.34 ±0.52 g/dl.
8) With regard to females, the same decrease has been observed; 16.85 ±0.45 g/dl and 15.34 ±0.56 at first and last day of admission respectively.
9) Un-compatible blood groups among the sample of neonates (males and females) are variable.
10) There was mildly high correlation between haemoglobin concentration and red blood cells count.
11) Values of total bilirubin for all neonates were high at the first day of admission. After the exact period of management, all values of total bilirubin were decreased to the normal values at the last day on admission.
12) Values of different parameters related to the hyperbilirubinemia were high at the beginning of admission. After a period of therapy, all high values were decreased to the normal range.

6. Recommendations

As a recommendation therefore, it is mandatory to screen, treat, and manage hyperbilirubinemic neonates and its associated risk factors in neonates admitted to STH. Based on strong research evidence, as well as the results of the current study, breastfeeding, prematurity, significant jaundice in a previous sibling, and jaundice noted before discharge from the nursery are the most common risk factors associated with severe hyperbilirubinemia. Based on research evaluating benefit versus harm, jaundice in the first 24 hours after birth is not physiologic jaundice and needs further evaluation.

• All newborns should undergo a risk assessment for hyperbilirubinemia before discharge from the newborn nursery and have appropriate follow-up evaluation after discharge.

• Visual assessment of jaundice does not assess the TSB reliably; clinicians should check either a TSB or transceutaneous bilirubin (TcB) when in doubt.

• The infant's age in hours is used when evaluating and managing bilirubin concentrations

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