Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 9337 - 9348
Received 05 March 2021; Accepted 01 April 2021.

Evaluation of Etiology and Treatment of Jaundice in Neonates Pursuit Phototherapy in a Tertiary Care Rreferral Hospital - A Prospective Cohort Study.

T. Balasubramanian *, R. Monika, M. Ramsheed, M. Rafih, M. Salman and P. Balan

Al Shifa College of Pharmacy, Poonthavanam P.O., Kizhattur, Perinthalmanna, Malappuram Dt., Kerala 679325, India

ABSTRACT

Aim: Neonatal jaundice, affects one in two infants globally, is a major cause of hospital admissions during the neonatal period. The aim of this study was to recognize the causes of jaundice in neonate's and to identify the efficacy of phototherapy.

Methods: A prospective cohort study was carried out among 495 new-borns with jaundice aged up to 7 days, both term and preterm in the department of neonatology for a period of 9 months. A data collection form was designed to collect the information. Neonatal and maternal assessments were done to assess the possible etiology of jaundice. Effectiveness of different treatments and phototherapy using different light sources was assessed.

Results: In our study as per the neonatal assessment, factors like low breast feeding (p=0.000), sepsis (p =0.006), hypoxia (p =0.003) and Glucose 6 phosphate dehydronase (p=0.000) are found to highly significant to the incidence of jaundice. According to the maternal assessment, factors like maternal ethnicity (p=0.000), thyroid status (p =0.000), history of neonatal jaundice (p =0.000), use of oxytocin infusion (p =0.004) and bruising during delivery (p =0.000,) are highly significant. This study shows that the most effective treatment was found to be exchange transfusion. Phototherapy was given in 78 % of the neonates.

Conclusion: Our study results conclude that there is highly significant relationship between low breast feeding and occurrence of neonatal jaundice. We believe that highly linked factor 'maternal history of neonatal jaundice' will bring up new treatment, prevention trends and early diagnosis for neonatal jaundice.

Keywords: Neonatal jaundice, Etiologies, Treatment options, Phototherapy

1. Introduction

Neonatal Jaundice is observed during the first weeks of life in approximately 60% of term infants and 80% of preterm infants.[1, 2] An imbalance between bilirubin production and conjugation is the main mechanism of jaundice, which leads to an increase in bilirubin levels. This imbalance often occurs due to the immature liver and the rapid breakdown of red blood cells, which may be involved with several factors.[3, 4] Nevertheless, diagnosis of new born jaundice and its management will play an important role in the health of new born.[5] Most new born babies have physiological jaundice. It is most noticeable when the baby is 2-4 days old. [6] Identification of predisposing factors in the management of the disease is important. Thus present study aims to recognize the causes of jaundice in neonate's pursuit phototherapy, the factors that place an infant's at risk for developing hyperbilirubinemia and to identify the efficacy of phototherapy.

2. Material and methods

2.1 *Study design*

A Prospective observational cohort study was carried out from 1st November 2019 to 1st May 2020 in the department of neonatology, Kims Al Shifa multispecialty hospital, Kerala for a period of 9 months with the

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 9337 - 9348
Received 05 March 2021; Accepted 01 April 2021.

aim to determine the Etiology and treatment of jaundice in neonates pursuits phototherapy. The study was approved by the ethics committee of Kim's Al Shifa hospital (KAS/ADMN/AC/EC/154/216).

2.2 *Procedure*

A total of 495 new-born patients in Neonatal department diagnosed with jaundice were selected based on inclusion and exclusion criteria. The nature, type or intention of the study was explained to the patients by direct patient interaction. Participants (parents) were then given time to decide whether or not to participate. If they decided to participate, written consent was obtained. A data collection form was designed to collect the information necessary for the study. The form consists of the details: Patient demographics, Neonatal assessment, Feeding pattern, Maternal assessment and Laboratory results. Sources of Data were Patients case record, Patient's prescription and Direct interactions with physician. Demographic profiles, details of disease and medications were collected from patient's case records. The severity of symptoms of Treatments measured using assessment of severity of symptom.ms threshold table. Careful clinical neonatal and maternal assessments were done to assess the possible etiology of jaundice. Effectiveness of the different treatment options, and phototherapy using different light sources, colours and emission spectrum was also evaluated in given population.

2.3 *Statistical Analysis*

The collected data for the study were compiled and analysed using SPSS version19. Chi-square test, student t test were used wherever found suitable and necessary interpretations were made. P value <0.05 was considered as significant.

3. Results

In our study as per the neonatal assessment many factors are significantly linked to the occurrence of jaundice and some factors are not. Factors like low breast feeding (26.5%, p =0.000, df=1), sepsis (7.8%, p =0.006, df=1), hypoxia (9.3%, p =0.003, df=1), G6PD (13.5%, p =0.000, df=1) and blood group incompatibilities (14.7%, p=0.000,df=1) are found to highly significant to the incidence of jaundice, and factors like gestational age (93.7%, p =0.015, df= 1), and cephalohematoma (4.4%, p=0.043, df=1) are significantly linked to the occurrence of neonatal jaundice. It is also observed that factors like UTI (1.2 %. p =0.298, df=1), gender (82.2%, p =0.298, df=1), Gilbert syndrome (6%, p =0.463, df=1), Dubin-Johnson syndrome (4%, p =0.549, df=1) are not significantly associated with neonatal jaundice **(Figure 1, Table 1).**

According to the maternal assessment, factors like maternal ethnicity (62.2%, p =0.000, df=2), thyroid status (8.1%, p=0.000, df=1),history of neonatal jaundice (71.1%, p =0.000, df=1), use of oxytocin infusion (8.7%, p =0.004, df=1), mode of delivery (61.4%), bruising during delivery (14.7%) and history of anemia (1.4%) are highly significant (p =0.000) to the occurrence of neonatal jaundice and factors like Maternal Hb count (2.4%, p =0.138, df=1), platelet count (2%, p =0.177, df=1), reticulocyte count (2%, p =0.672, df=1), maternal age (4%, p =0.549, df=1), gestational DM (11.1%, p =0.352, df=1), Number of delivery (3.2%, p =0.086, df=1), delayed cord cutting (1.6%, p =228, df=1), History of abortion(2%, p =0.672, df=1) and history of thalassemia (1.8%, p =0.298, df=1) are not linked to the incidence of neonatal jaundice **(Figure 2, Table 1).**

Our study shows that the most effective treatment was found to be exchange transfusion, then IV immunoglobulin, phototherapy, breast feed correction, and antibiotic therapy in the same order **(Figure. 3, Table 2).** In phototherapy the most effective light source was found to be LED, then FT and Halo spot light **[Fig. 4, Table 2]**. The most effective colour (used in phototherapy light) was found to be green than blue as per our study **(Figure 5, Table 3),** and we are not able to find the effective emission spectrum used in phototherapy as all of them receive the same emission spectrum (350-550nm) and nothing to be compared with **(Table 2, and 3).**

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 9337 - 9348
Received 05 March 2021; Accepted 01 April 2021.

Item	**Category**	**Before treatment (micromol / liter in infants aged 96 hours or more)**		**Total**	**Pearson chi square test**	**Pvalue**	**df**
		>350	**>450**				
1. Gestational Age	34 to 37 weeks	31 (6.3%)	0 (0%)	495	5.906a	0.015	1
	38-42 weeks	389 (93.7%)	75 (100%)				
2.Maternal ethnicity	Black	109 (26%)	0 (0%)	495	53.667a	0	2
	White	78 (18.6%)	0 (0%)				
	Asian	233 (55.5%)	75 (100%)				
3. Gender	Male	344 (81.9%)	63 (84%)	495	.191a	0.662	1
	Female	76 (18.1%)	12 (16%)				
4. Term	Term babies	131 (31.2%)	47 (62.7%)	495	27.378a	0	1
	Pre Term babies	289 (68.8%)	28 (37.3%)				
5. Breast feeding pattern	Low breast feeding	131 (31.2%)	0 (0%)	495	31.812a	0	1
	Normal breast feeding	289 (68.8%)	75 (100%)				
6. Cephalohematoma	with cephalohematoma	22 (5.2%)	0 (0%)	495	4.111a	0.043	1
	without cephalohematoma	398 (94.8%)	75 (100%)				
7. Sepsis	With Sepsis	39 (9.3%)	0 (0%)	495	7.560a	0.006	1
	Without Sepsis	381 (90.7%)	75 (100%)				
8. Hypoxia	With Hypoxia	46 (11%)	0 (0%)	495	9.056a	0.003	1
	Without Hypoxia	374 (89%)	75 (100%)				
9. G6PD	With G6PD	67 (16%)	0 (0%)	495	13.837a	0	1
	Without G6PD	353 (84%)	75 (100%)				
10. Gillbert syndrome	With Gillbert syndrome	3 (0.7%)	0 (0%)	495	0.539a	0.463	1
	Without Gillbert syndrome	417 (99.3%)	75 (100%)				
11. Dubin johnson syndrome	With Dubin johnson syndrome	2 (0.5%)	0 (0%)	495	0.359a	0.549	1
	without Dubin johnson syndrome	418 (99.5%)	75 (100%)				
12. Blood group incompatibility	With Blood group	0 (0%)	73 (97.3%)	495	479.517a	0	1

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 9337 - 9348
Received 05 March 2021; Accepted 01 April 2021.

	incompatibility						
	Without Blood group incompatibility	420 (100%)	2 (2.7%)				
13.Urinary tract infection	With UTI	6 (1.4%)	0 (0%)	495	1.085a	0.298	1
	Without UTI	414 (98.6%)	75 (100%)				
14. High Hb count	High Hb	12 (2.9%)	0 (0%)	495	2.196a	0.138	1
	Normal Hb	408 (97.1%)	75 (100%)				
15. Platelet count	High Platelet count	10 (2.4%)	0 (0%)	495	1.823a	0.177	1
	Normal	410 (97.6%)	75 (100%)				
16. MCV	Abnormal	2 (0.5%)	0 (0%)	495	0.359a	0.549	1
	Normal	418 (99.5%)	75 (100%)				
17. Hct	High	10 (2.4%)	0 (0%)	495	1.823a	0.177	1
	Normal	410 (97.6%)	75 (100%)				
18. WBC	High	10 (2.4%)	0 (0%)	495	1.823a	0.177	1
	Normal	410 (97.6%)	75 (100%)				
19. Reticulocyte count	Abnormal	1 (0.2%)	0 (0%)	495	0.179a	0.672	1
	Normal	419 (99.8%)	75 (100%)				
20. Maternal weight	Abnormal	2 (0.5%)	0 (0%)	495	0.359a	0.549	1
	Normal	418 (99.5%)	75 (100%)				
21. Maternal age	Abnormal	2 (0.5%)	0 (0%)	495	0.359a	0.549	1
	Normal	418 (99.5%)	75 (100%)				
22. Gestational diabetesmellitus	With Gestational diabetesmellitus	49 (11.7%)	6 (8%)	495	0.866a	0.351	1
	Without Gestational DM	371 (88.3%)	96 (92%)				
23. Maternal thyroid status	Abnormal	0 (0%)	40 (53.3%)	495	243.692a	0	1
	Normal	420 (100%)	35 (46.7%)				
24. Maternal H/o of neonatal jaundice	had jaundice	277 (66%)	75 (100%)	495	35.910a	0	1
	Do not had jaundice	143 (34%)	0 (100%)				
25. Number of	Non primi mother	404	75 (100%)	495	2.953a	0.086	1

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 9337 - 9348
Received 05 March 2021; Accepted 01 April 2021.

delivery		(96.2%)					
	primi mother	16 (3.8%)	0 (0%)				
26. Use of oxytocin infusion	Those use	43 (10.2%)	0 (0%)	495	8.409a	0.004	1
	Those not use	377 (89.8%)	75 (100%)				
27. Mode of delivery	Normal	284 (67.6%)	20 (26.7%)	495	45.037a	0	1
	Caesarean	136 (32.4%)	55 (38.6%)				
28. Bruising during delivery	Suffered	73 (17.4%)	0 (0%)	495	15.291a	0	1
	Not suffered	347 (82.6%)	75 (100%)				
29. Delayed cord cutting	Delayed cutting	8 (1.9%)	0 (0%)	495	1.452a	0.228	1
	Normal cutting	412 (98.1%)	75 (100%)				
30. PROM	Had rupture	1 (0.2%)	0 (0%)	495	0.179a	0.67	1
	Had no rupture	419 (99.8%)	75 (100%)				
31. History of abortion	Had history of abortion	1 (0.2%)	0 (0%)	495	0.179a	0.67	1
	No history of abortion	419 (99.8%)	75 (100%)				
32. Drug taken by mother during pregnancy / delivery	Taken	141 (33.6%)	0 (0%)	495	35.207a	0	1
	Not taken	279 (66.4%)	75 (100%)				
33. Maternal history anaemia	Had history	0 (0%)	7 (9.3%)	495	39.762a	0	1
	Had no history	420 (100%)	68 (90.7%)				
34. Maternal history of thalassemia	Had history	6 (1.4%)	0 (0%)	495	1.085a	0.29	1
	Had no history	414 (98.6%)	75 (100%)				

Table 1-Cross tabulation of different etiological factors and bilirubin level before treatment

Types of Therapy	**Number**	**Serum Bilirubin level**	**Mean**	**Std deviation**	**Mean difference**	**Std deviation**	**P value**	**t value**	**Confidence interval**	
									Lower limit	**Upper limit**
1. Breast feed correction	131	Before treatment	396.7	28.59	291.49	39.02	0.00	85.48	284.75	298.24
		after treatment	105.2	22.23						
2 Antibiotic therapy	45	Before treatment	365.4	11.66	287.6	14.44	0.00	133.5	283.25	291.94
		after treatment	77.8	8.1						

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 9337 - 9348
Received 05 March 2021; Accepted 01 April 2021.

3 Phototherapy	378	Before treatment	387.9	45.26	295.62	57.31	0.00	100	289.81	301.43
		after treatment	92.27	39.68						
4 Exchange transfusion	73	Before treatment	474.3	16.87	379.02	50.54	0.00	64.07	367.23	390.82
		after treatment	95.26	58.09						
5. IV. Immunoglobulin	10	Before treatment	488.3	31.55	335.7	115.6	0.00	9.18	253	418.39
		after treatment	152.6	140.33						
6. Phototherapy using LED	180	Before treatment	414	54.68	327.58	57.05	0.00	77.03	319.19	335.98
		after treatment	86.44	38.29						
7. Phototherapy using FT	180	Before treatment	365	9.71	270.97	40.52	0.00	89.71	265.02	276.93
		after treatment	94.06	40.407						
8. Phototherapy using Halo spot light	18	Before treatment	364.3	12.46	231.83	12.77	0.00	76.96	225.47	238.18
		after treatment	132.4	4.04						
9.Phototherapy using blue light	310	Before treatment	369.9	24.32	275.54	39.72	0.00	122.1	271.1	279.98
		after treatment	94.31	42.81						
10. Phototherapy using green light	68	Before treatment	472.6	12.64	389.63	22.01	0.00	146	384.3	394.96
		after treatment	82.92	15.95						

Table 2 -Effectiveness of different treatment options.

Table 3- Descriptive statistics for light source used in phototherapy.

Parameter		**Number**	**Mean**	**Std. Deviation**	**Std. Error**	**95% Confidence Interval for Mean**		**Min.**	**Max.**
						Lower Bound	**Upper Bound**		
Serum bilirubin (Before)	LED	180	414	54.68	4.07	405.99	422.07	350	548
	FT	180	365	9.71	0.72	363.61	366.47	350	399
	HALO SPOT LIGHT	18	364.3	12.46	2.93	358.07	370.47	350	389
	Total	378	388.3	45.53	2.34	383.73	392.94	350	548

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 9337 - 9348
Received 05 March 2021; Accepted 01 April 2021.

Serum bilirubin (After)	LED	180	86.44	38.29	2.85	80.81	92.07	67	436
	FT	180	94.06	40.4	3.01	88.12	100	64	239
	HALO SPOT LIGHT	18	132.4	4.047	0.95	130.43	134.45	125	137
	Total	378	92.26	39.58	2.03	88.26	96.26	64	436
Difference in Serum Bilirubin	LED	180	327.6	57.05	4.25	319.19	335.98	94	426
	FT	180	271	40.52	3.02	265.01	276.93	143	324
	HALO SPOT LIGHT	18	231.8	12.77	3.01	225.47	238.18	213	259
	Total	378	296.1	57.48	2.95	290.25	301.88	94	426

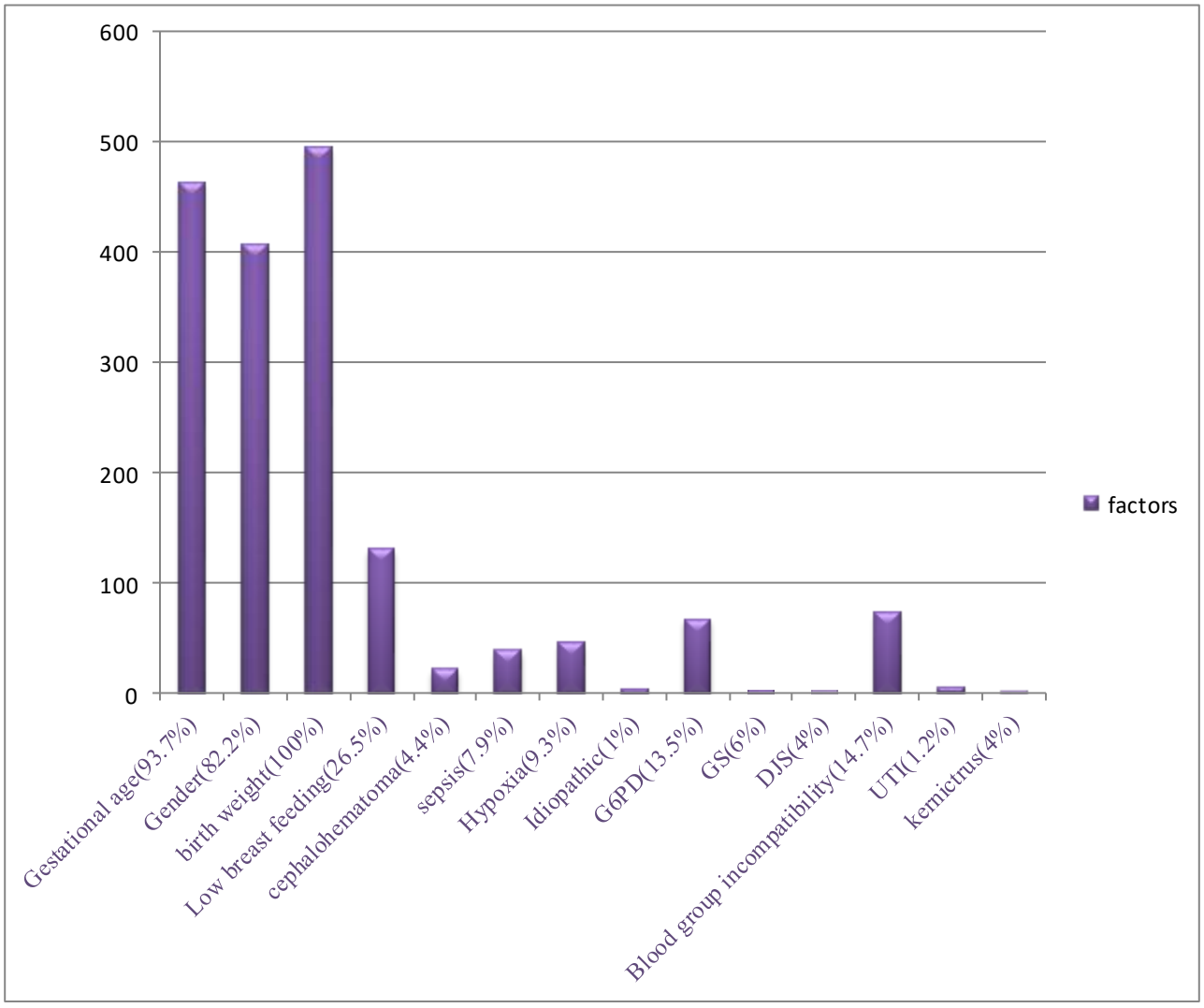

Figure 1- Neonatal Assessment.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 9337 - 9348
Received 05 March 2021; Accepted 01 April 2021.

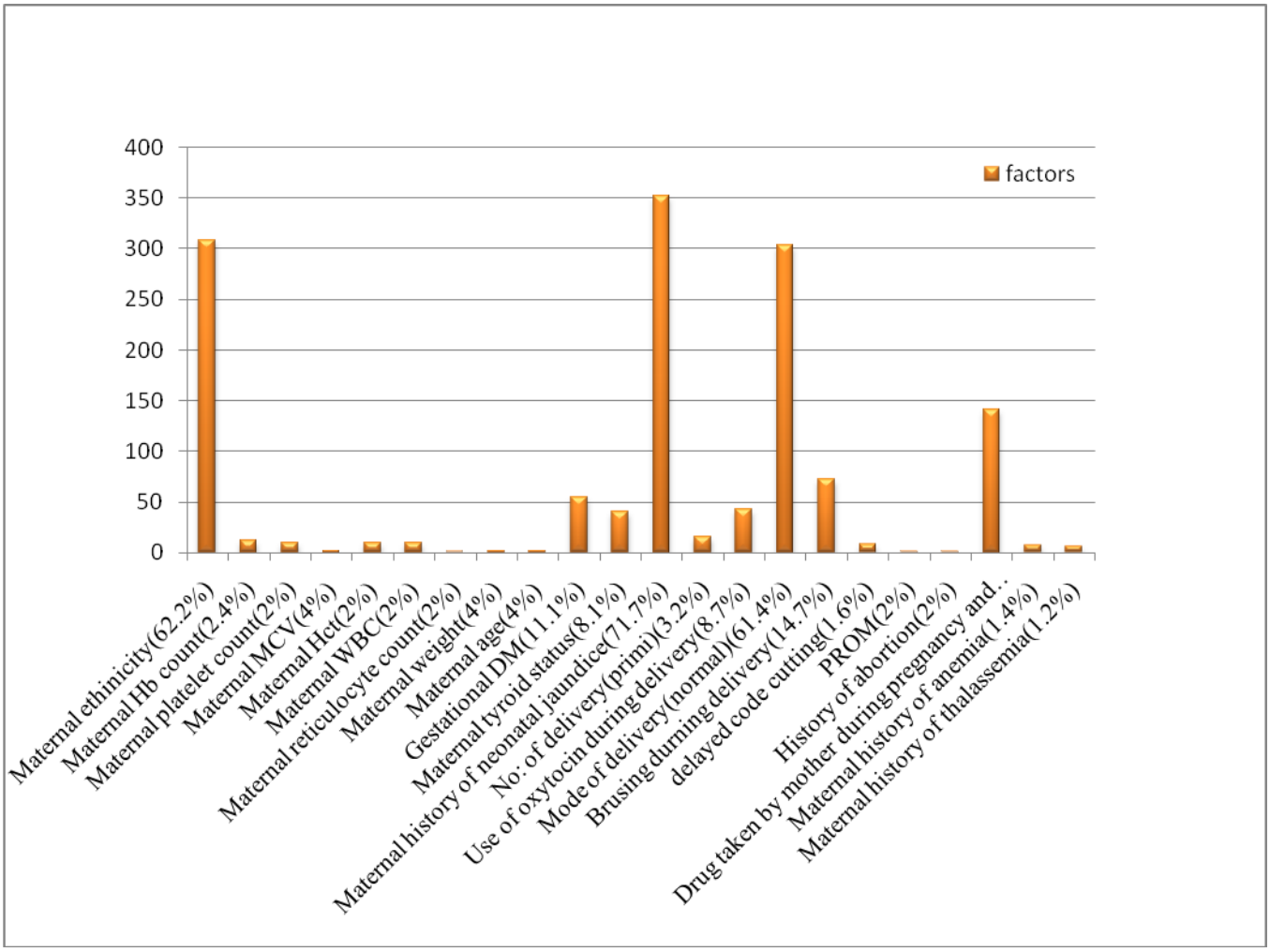

Figure 2 - Maternal Assessments.

Figure 3 -Effectiveness of different treatments on given population.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 9337 - 9348
Received 05 March 2021; Accepted 01 April 2021.

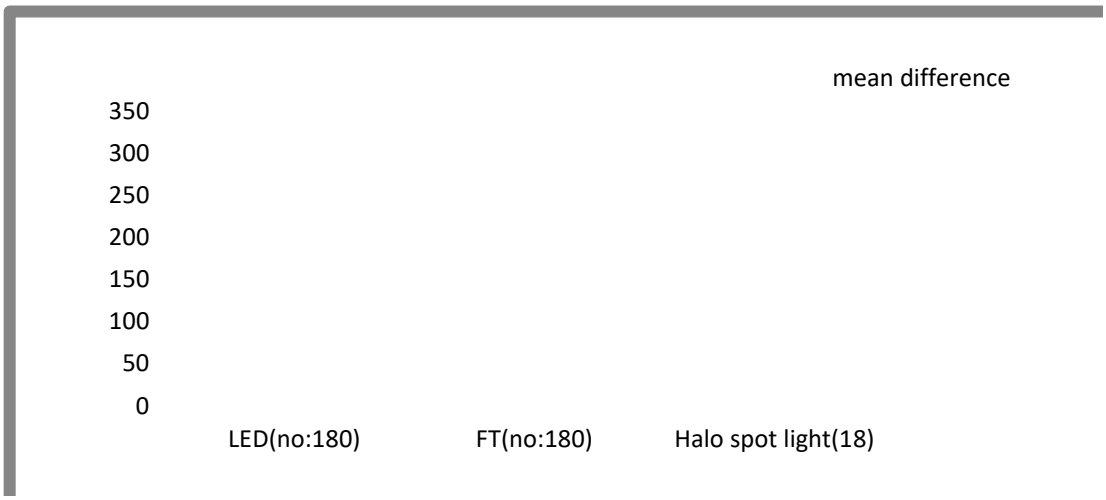

Figure 4 -Effectiveness of light source used in phototherapy

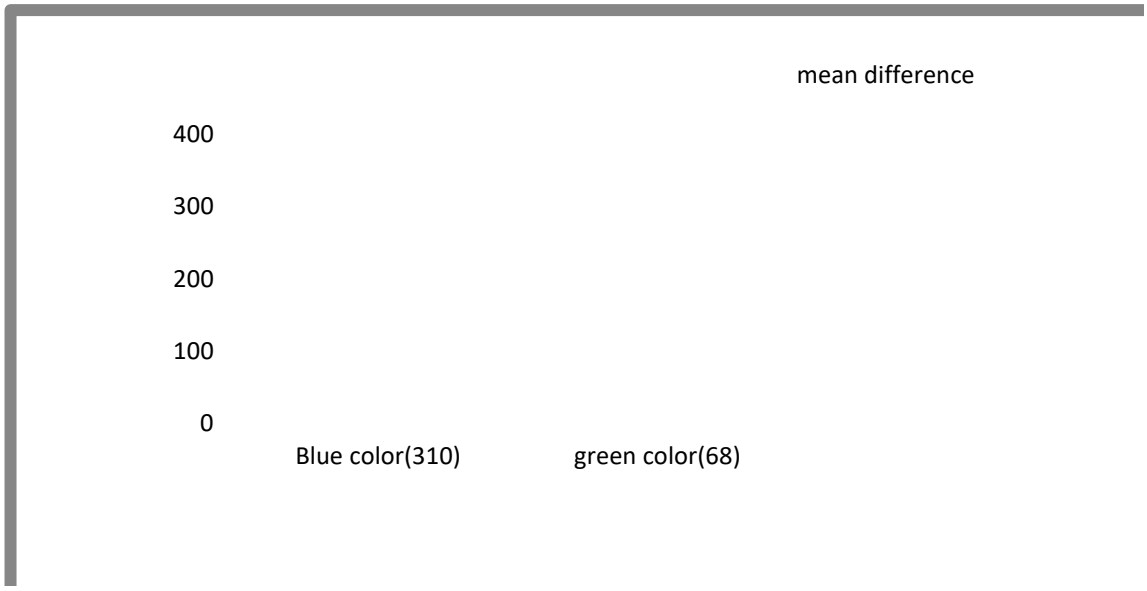

Figure 5- Effectiveness of light colour used in phototherapy.

4. Discussion

In our study, 93.7 % were having gestational age between 38-42 weeks and 6.3% were between 34-37 weeks. Study conducted by Sarici SU et al has described that risk of hyperbilirubinemia significantly increases with decreasing gestational age [7,8]. Our study results conclude that there is highly significant relationship between low breast feeding and occurrence of neonatal jaundice (p =0.000, df=1). A study conducted by Ying-Juang Chen et al reveals that increased breast feeding and shorter hospital stays were suggested as contributing factors to the significant rate of hyperbilirubinemia and the reemergence of kernicterus. [9, 10] Our study results shows that cephalohematoma (p =0.043, df=1), sepsis (p =0.006, df=1) and hypoxia (p =0.003, df=1) are highly significant with the occurrence of neonatal jaundice. In our study G6PD is found in 13.5% of neonates, which means G6PD is a leading cause of neonatal jaundice. A study conducted by Ching-shan

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 9337 - 9348
Received 05 March 2021; Accepted 01 April 2021.

Huang et al describes that Glucose-6-phosphate dehydrogenase is the most common human genetic enzymopathy, which is closely associated with neonatal hyperbilirubinemia.[11] In our study 6% of newborn have Gilbert syndrome (GS). A study conducted by John D. Bancroft et al proves that the newborn infants with the molecular markers for Gilbert syndrome have an accelerated increase in neonatal jaundice during the first 2 days of life.[12] Our study describes that blood group incompatibility was highly significant with the occurrence of neonatal jaundice especially ABO incompatibility (p =0.000,df=1). Our research describes that maternal thyroid status was highly significant with the occurrence of neonatal jaundice (p =0.000, DF=1). In our study 71.1% had a history of neonatal jaundice. To the best of our knowledge, this is the first study focus on the factor maternal history of neonatal jaundice and found a positive relationship like this. Our study describes that use of oxytocin during delivery was highly significant with the occurrence of neonatal jaundice (p =0.004, df=1). Oxytocin also increases RBC lysis while passing through the vessels, thus leading to hyperbilirubinemia.[13,14,15,16] Out of the total of 495, 304 baby born by normal delivery and rest of 191 born by cesarean. Our study concludes that baby born by normal delivery was highly significant with the occurrence of neonatal jaundice (p =0.000,df=1). A study conducted by Ehsan Garosi et al shows that the mean total bilirubin levels was significantly higher in newborns delivered vaginally compared to cases born by cesarean section [15]. Out of the total 495, 14.7% neonates had suffered bruising during their delivery. This results shows that bruising during delivery is a source of development of jaundice. A study conducted by S.W.D'souza et al describes that, in the neonatal period, babies had excessive scalp bruising surrounding an area of skin damage and subcutaneous necrosis where the spiral electrode had been applied.[17]

We observed that there is highly significant correlation between steroid drug taken by mother before or during pregnancy and neonatal jaundice (p =0.000, df=1). Our study shows that maternal history of anaemia was highly significant with the occurrence of neonatal jaundice (p =0.000, df=1). Study conducted by Audrey K. Brown have a different opinion that infants born to women with sickle cell disease are at greater risk of neonatal jaundice.[18] Breast feed correction is given for those neonates who develop jaundice as a result of abnormal feeding patter or low breast feeding, that is low breast feeding is found in 26.5% of neonates. The one of the main limitation, in finding the effectiveness of different treatment is that same individual receives multiple therapies and the exposure group is different in receiving different treatments. Phototherapy is a safe, effective method for decreasing or preventing the rise of serum unconjugated bilirubin levels and reduces the need for exchange transfusion in neonates. Phototherapy was given in 378 neonates. A study conducted by Michael W et al has proved that phototherapy was 85% effective in preventing TSB≥25mg/Dl.[19]

5. Conclusion

Our study results conclude that there is highly significant relationship between low breast feeding and occurrence of neonatal jaundice. So, we suggest the 10 steps put forward by WHO to successful breast feeding. To the best of our knowledge, this is the first study focus on the factor maternal history of neonatal jaundice and found a positive relationship like this. We believe that highly linked factor 'maternal history of neonatal jaundice' will bring up new treatment, prevention trends and early diagnosis for neonatal jaundice. Our study concludes that the most effective treatment was found to be exchange transfusion, then IV immunoglobulin, phototherapy, breast feed correction and antibiotic therapy in the same order. In phototherapy the most effective light source was found to be LED, then FT and Halo spot light. Due to high incidence of G6PD deficiency, it is recommended to introduce qualitative test of this enzyme as a routine laboratory investigation for all icteric neonates so as to get an early diagnosis and to avoid complications.

Conflicts of interest

The authors declare no relevant conflicts of interest.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 9337 - 9348
Received 05 March 2021; Accepted 01 April 2021.

Acknowledgements

We acknowledge the valuable comments and suggestions by Dr Moideen Babu, Consultant Neonatologist, during this project. The authors would like to thank the staff, Department of Nephrology, Al Shifa Hospital, and Department of Pharmacy Practice, Al Shifa College of pharmacy for supporting this work.

Funding Source

Funding for the research project was provided by Al ShifaCollege of Pharmacy, Shifa Institute of Medical Sciences, Shifa Medicare Trust, Perinthalmanna, Kerala.

REFERENCES

1. Ullah S, Rahman K, Hedayati M. Hyperbilirubinemia in Neonates: Types, Causes, Clinical Examinations, Preventive Measures and Treatments: A Narrative Review Article. *Iran J Public Healt.* 2016;45(5):558–568. PMID: 27398328; PMCID: PMC4935699.
2. Kliegman RM, Behrnan RE, Jensen HB, Stranton B. Nelson Textbook of Pediatrics: Jaundice and huperbilirubinemia in the newborn. 19th ed. Philadelphia: Saunders; 2012.
3. IAP-NNF National Task Force 2006 on guidelines for level II neonatal care. IAP-NNF guidelines 2006 on level II neonatal care. Jaundice in newborn; p. 187–210
4. Sayed YM, Anahita I, Golnar S, *et al.* Risk Factors Associated with Neonatal Jaundice: A Cross-Sectional Study From Iran. *Open Access Maced J Med Sci.* 2018;6(8):1387– 1393. PMCID: PMC6108787 DOI: 10.3889/oamjms.2018.319
5. Fanaroff AA, Martin RJ. Neonatal-perinatal medicine: diseases of the fetus and infant. Arch Dis Child Fetal Neonatal Ed 2006:91(6); F468.
6. Kleigman R, Bonita S, Richard E, Joseph St. Nelson text book of paediatrics: Translation by Nurozi E, Mohammadpor M. and Fallah R. 3rd ed. Tehran: Andisheh Rafi; 2007.
7. Newman TB, Xiong B, Gonzales VM, *et al.* Prediction and prevention of extreme neonatal hyperbilirubinemia in a mature health maintenance organization. *Arch Pediatr Adolesc Me.* 2000;154(11):1140–1147.
8. Sarici SU, Serdae MA, Korkmaz A, et.al. Incidence, course and prediction of hyperbilirubinemia in near-term and term newborns. *Pediatrics.* 2004;113(4):775–780.
9. Ying-Juang C, Wei-Chuan C, Chung-Ming C. Risk factors for hyperbilirubinemia in breastfed term neonates. Eur J Pediatr. 2012: 171(1); 167–171. 10.1007/s00431-011-1512-8
10. Iyer NP, Srinivasan R, Evans K, *et al.* Impact of an early weighing policy on neonatal hypernatremic dehydration and breast feeding. *Arch Dis Child.* 2008; 93:297–-299.
11. Chin S H, Kun L H, May JH, *et al*. Neonatal Jaundice and Molecular Mutations in Glucose-6-Phosphate Dehydrogenase Deficient Newborn Infants. *Am. J. Hematol.* 1996;51:19–25.
12. John D, Glenn R, Bill K. Gilbert syndrome accelerates development of neonatal jaundice. *J Pediatr.* 1998;132:656-60.
13. Litvinov RI, Weisel JW. Role of red blood cells in haemostasis and thrombosis. ISBT science series. 2017;*12*(1):;176–183. https://doi.org/10.1111/voxs.12331
14. Chang PF, Lin YC, Liu K, *et al.* Risk of hyperbilirubinemia in breast fed infants. *J Pediatr*. 2011;159(4):561–565.
15. Hannam S, McDonnell M, Rennie JM. Ivestigation of prolonged neonatal jaundice. *Acta Pediatr*. 2000; 89(6):;694–697.
16. Mereena G, Betsy T, Sreenivasan VK . Incidence of Hyperbilirubinemia in Neonates of Parturients Undergoing Augmentation of Labor With Oxytocin: A Prospective Cohort Study.

Indian J Obstet Gynecol. 2019;7 (4) (Part-II): 579–593. DOI: http://dx.doi.org/10.21088/ijog.2321.1636.7419.3

17. Souza SWD, Patricia B, Macfarlane T. Fetal scalp damage and neonatal jaundice: a risk of routine fetal scalp electrode monitoring. *J Obstet Gynaecol*. 1982; 2(3):161–164.
18. Audrey KB, Lynn AS, Charles HP, *et al.* The Influence of infant and maternal sickle cell Disease on Birth Outcome and Neonatal Course. *Arch Pediatr Adolesc Med*. 1994;148:1156-1162
19. Michael WK, Gabriel JE, Soora W, *et al.* Risk Factors for Severe Hyperbilirubinemia among infants with Borderline Levelss: A Nested Case–Control Study. *J Pediatr*. 2008; 153(2): 234–240.