Comparison of Visual Assessment of Neonatal Jaundice by Kramer's rule with total serum bilirubin levels in a Tertiary care hospital of Nepal.

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ABSTRACT

Introduction:- Neonatal jaundice is one of the most frequently encountered clinical problems in newborns. Early intervention is needed to prevent complications caused by increased level of serum bilirubin. Kramer's method is a non invasive visual assessment technique to estimate the bilirubin levels in neonates with jaundice especially useful in low income settings like Nepal. This study was conducted to determine whether visual assessment of neonatal jaundice could serve as a screening step for neonatal hyperbilirubinemia and this type of non-invasive measurement of neonatal jaundice has not been done in our settings.

Materials and Methods:- A prospective cross sectional study was performed over a period of 12 months at Emergency Ward, Neonatal Intermediate Care Unit (NIMCU), Neonatal Intensive Care unit (NICU) of Kanti Children's Hospital, Maharajgunj Kathmandu where term neonates with jaundice were assessed visually for jaundice by a single pediatrician and categorized into different dermal zones according to Kramer's rule and mean of three observations was taken as visual estimation of jaundice and compared with total serum bilirubin levels.

Results:- The common causes of neonatal jaundice were physiological jaundice (56.17%) low birth weight (18.5%) and sepsis (17.3%). The visual assessment of neonatal jaundice was highly correlated with total serum bilirubin level (Pearson's correlation coefficient=0.837 with p value <0.0001).

Conclusion

Visual assessment of neonatal jaundice by Kramers's rule was highly correlated with total serum bilirubin level. So, it can be used as a screening tool for predicting neonatal hyperbilirubinemia.

Keywords:- Kramer's criteria, Neonatal hyperbilirubinemia, Neonatal sepsis

INTRODUCTION

Jaundice is defined as yellowish discoloration of the body and sclera due to deposition of bilirubin and manifests when serum bilirubin level is more than 7 mg/dl.[1] Eighty percent of preterm neonate and 60% of term neonates develop jaundice in their first week of life.[2] There is no data available regarding incidence of neonatal jaundice in Nepal. In Kanti children hospital there were total 99 admissions in Neonatal Intermediate Care Unit (NIMCU) in the year (2071 to 2072) with diagnosis of neonatal jaundice.[3]

Associated risk factors of neonatal jaundice are Asian race, preterm(PT) babies, breast feeding(BF),weight loss(WL), family history of or a sibling who had physiological jaundice, cephalohematoma, oxytocin induction ,male sex, trisomy 21 , maternal diabetes, glucose 6 phosphate dehydrogenase deficiency (G6PD), polycythemia, and drugs (novobiocin, vitamin k3).[4]

Bilirubin is estimated by using two techniques i.e. invasive techniques and non-invasive techniques. Invasive technique involves measurement of urine urobilinogen and serum bilirubin level in blood. Non- invasive technique includes assessment of neonatal jaundice visually by Kramer's criteria and by using transcutaneous bilirubinometer. Clinical assessment can be done to estimate total serum bilirubin (TSB) by using Kramer's scale.[5] The scale is based on cephalo-caudal progression of jaundice. The total bilirubin level is correlated to 5 specific dermal zones,(1) head and neck, (2) upper trunk ,(3)lower trunk and thighs,(4)arms and legs below the knees and(5) hands and feet. It is assumed that an increasing zone of staining corresponds with the increasing levels of serum bilirubin.[5] Lowest TSB levels were associated with yellow discoloration of head and neck, and highest levels, with the discoloration extended to palm and soles.[6] Elevation of bilirubin in neonates can lead to kernicterus, acute bilirubin encephalopathy with focal neurological deficit (eg. sensory neural hearing loss) neurobehavioral problems and intelligence quotient deficits. So early intervention may prevent complications caused by increased level of bilirubin.[7] Though neonatal jaundice is a common problem; it rarely reaches levels that require intervention. Frequent assessment of serum bilirubin levels may cause unnecessary trauma to the infants and cause anxiety to family and it also increases cost to the family. In Nepal no study had been conducted to find out the accuracy of visual estimation of jaundice by Kramer's rule in comparison to total serum bilirubin level. This study is conducted to determine whether the clinical estimation of jaundice by experienced clinician could serve as a screening step for neonatal hyperbilirubinemia without missing any baby with significant hyperbilirubinemia.

MATERIALS AND METHODS

The study was a hospital based, prospective cross-sectional, conducted in Kanti Children's Hospital, Kathmandu. The study was conducted on Out Patient Department, Emergency Department, NIMCU and NICU of Kanti Children's Hospital, Kathmandu over one year period from January 2016 to December 2016. All term neonates having jaundice irrespective of birth weight attending Emergency, Out Patient Department and neonates admitted in NIMCU and NICU were included in the study after obtaining informed consent. . Those who failed to give consent, preterm neonates, neonates who received phototherapy previously and neonates who had already undergone exchange transfusion were excluded from the study.

Sample size was calculated according formula $n= Z\alpha^2 PQ/d^2$ where, n= required sample size, Zα= Z deviate corresponding to deviate reliability level(1.96) for 95% reliability, P= estimated proportion in the population (0.12), Q=1-P(0.88),d = maximum acceptable error (5%) ·The sample size was calculated as 162.

A complete history including introduction of neonates with demographic details, symptoms were taken. Examination included vital signs and other relevant systemic findings. Age, gender, gestational age of neonate was recorded. Examination and observation of newborns for presence of jaundice was done by single pediatrician. Clothes of infants were removed and the skin of neonate was blanched by digital pressure over skin and the color was noted in well lit room or daylight near window. Three different observations for clinical estimation of jaundice visually at three different timings i.e. at an interval of one hour in each observation. By recognizing the position of skin where jaundiced and non-jaundiced skin meet was observed and categorization was done into five dermal zones according to Kramer's rule. Neonates having jaundice up to head and neck were categorized as zone 1 (bilirubin level ≤ 5

mg/dl), jaundice up to upper abdomen as zone 2 (bilirubin level >5-10 mg/dl). Similarly jaundice up to upper thigh was categorized as zone 3 (bilirubin level >10-12 mg/dl), jaundice up to ankles and wrist was categorized as zone 4 (bilirubin level >12-15 mg/dl) and jaundice up to palms and soles as zone 5 (bilirubin level >15 mg/dl) .[5] The mean value of the three observations was taken and recorded as the visual estimation of jaundice in the neonate in pro-forma. Simultaneously venous blood sample was drawn and sent to laboratory for serum bilirubin estimation which was measured by BR-501 bilirubinometer machine, made in Japan, 2010. Septic screening was done which included total blood counts, differentials, hemoglobin, platelets, C- reactive protein, blood culture and urine routine/microscopy; chest x-ray and Direct Coombs Test (DCT)were performed when needed. All reports were filled in the pro-forma of the study only after recording clinical estimation of bilirubin level. Data was analyzed using SPSS (Statistical Package for social Science) software, version 16; Pearson's correlation coefficient (to evaluate effective parameter on dependent variable) was used accordingly. Informed written consent was taken from the patient's parent or guardians or care taker. Approval and ethical clearance were given by the Institutional Review Board for research (IRB), Kanti Children's Hospital.

RESULTS

In this study, total number of cases were 162 neonates among which 94(57.91%) were male whereas 68 (41.95%) were female neonates. The most common age group presented with neonatal jaundice was between 2-7 days of life.

Table no 1 - Age wise distribution of study population

Age	Total	No of male neonate (%)	No of female neonate (%)	Percentage
≤ 1 days	11	4 (2.46%)	7 (4.32%)	6.79%
2-7 days	91	53 (32.7%)	38 (23.45%)	56.17%
8 to 14 days	34	22 (13.5%)	12 (7.40%)	20.9%
15 to 21 days	17	9 (5.55%)	8 (4.93%)	10.4%
22 to 28 days	9	6 (3.70%)	3 (1.85%)	5.55%
Total	162	94(57.91%)	68 (41.95%)	100%

In this study population, maximum numbers of patients were from age group 2-7 days of life 91 (56.17%), ≤ 1 day were 11 babies (6.79%), 8- 14 days of life were 34(20.9%), 15-21 days of life were 17 (10.4%) and 22 to 28 days of life were 9 (5.55%).

Table no 2- Distribution of neonates according to dermal zones

Zones	Number (n=162)	Mean age of presentation (days)	Standard deviation
Zone 1	39 (24.07%)	8.92	7.600
Zone 2	51(31.42%0	7.55	6.607
Zone 3	21(12.9%)	5.05	4.383
Zone 4	14(8.64%)	8.07	5.269
Zone 5	37(22.82%)	8.78	6.010
Total	162(100%)	7.88	6.428

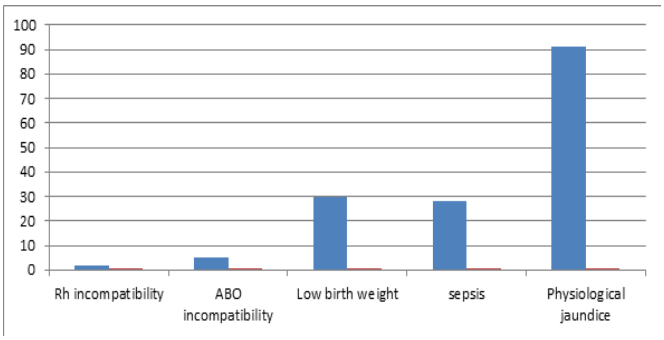
Out of 162 patients, 39 patients lied in dermal zone 1(24.07%), 51 babies lied in dermal zone (31.42%), 21 patients lied in dermal zone 3 (12.9%), 14 patients lied in dermal zone 4 (8.64%), 37 babies lied in dermal zone 5 (22.82%).

Table no 3. Incidence of various risk factors for hyperbilirubinemia

Risk factor	Number (n=162)	Percentage (%)
Cephalhematoma	2	1..25
Formula feeding	2	1.2%
H/o jaundice in siblings	15	9.3
Family history of jaundice	14	8.6
Oxytocin use	4	2.5
Urinary tract infection	2	1.2
Birth asphyxia	11	6.8
Breast feeding	141	87.0

In this study ,out of 162 study population, 1.25% had cephalohematoma, 1.2% had exclusive formula feeding ,141(87%) had exclusive breast feeding ,11(6.8%) had birth asphyxia ,2(1.2%) had urinary tract infection , 14 neonates(8.6%) had family history of jaundice, 15(9.3%) had h/o jaundice 4(2.5%) had history of maternal oxytocin use during labour.

Table no 4. Causes of jaundice



In this study out of 162 , 2(1.2%) neonates had Rh incompatibility, 5(3%) neonates had ABO incompatibility and 28(17.3%) had neonates had sepsis,30 (18.5%) were low birth weight and 91(56.17% had physiological jaundice.

Table 5. Correlation between visual assessment and laboratory estimation of Bilirubin

	Correlations	Total serum bilirubin	Visual estimation of jaundice
Total serum bilirubin	Pearson Correlation	1	0.837**
	p-value		.0001
	N	162	162
Visual estimation of jaundice	Pearson Correlation	0.837**	1
	p-value	.0001	
	N	162	162
**. Correlation is significant at the 0.01 level (2-tailed).			

In this study the corelation between visual assessment of neontal jaundice with total serum bilirubin was found to be significant (pearson's correlation coefficient was 0.837) with p value 0.001.

DISCUSSION

Neonatal jaundice is one of the most frequently encountered clinical problems in newborns. It is also a common cause of readmission to hospital after early discharge of newborn babies.Neonatal jaundice can be entirely physiological or it can be pathological with associated toxicities to the central nervous system. Majority of cases in this study were male with male to female ratio of 1.38:1. The reason for the male predominance is due to male gender itself is one of the risk factors for hyperbilirubinemia.[8]It may be due to cultural practice of health service seeking behaviour for male babies being higher in comparision to female babies.

Out of 11 neonates who presented within 24hrs of life, 2 babies had ABO incompatibilty, 2 babies had positive family history of jaundice but cause of jaundice in 7 babies was unknown. The tests for G6PD and other enzymes could not be done in this study because of unavailability of the laboratory facilities and financial reasons. Majority of neonates in this study presented in hospital within 2-7 days of life with physiological jaundice. This is similar to study done by Dhanjal et al, where the majority of neonates had physiological jaundice (60%).[9] This can also be explained by the nature of physiological jaundice.

The main causes for neonatal jaundice in this study were sepsis (17.3%) followed ABO incompatibility(3%)by Rh incompatibility(1.2%). This is supported from study done by Kaini et al who found out the main causes for neonatal jaundice were sepsis(25.9%) followed by ABO incoompalibility (11.1%) and Rh incompatibility(7.4%) respectively.[10] In this study cephalhematoma was found only in 2 cases. Similarly study done by Koosa et al showed presence of cephalhematoma in 0.5% of cases as a risk factor for neonatal jaundice.[11] In our study birth asphyxia was noted in 6.8% of study population which is supported by study done by Tiker et al who found out birth asphyxia (16.7%) as second most common cause for neonatal jaundice[12] In our study oxytocin used during labour was found in only in 4 cases (2.5%). Exclusive breast feeding was found in 141(87%) of cases in our study and formula feeding was present in 1.2% cases. In majority of cases neonates are fed exclusively by their mother. American Academy of Pediatrics (AAP) also suggests exclusive breast feeding as a major risk factor for neonatal jaundice particularly if nursing is not going well and weight loss is excessive.[13] But weight loss due to poor nursing if present could not be measured in this study. Study done by Huang et al also found that exclusive breast-feeding and less body weight loss during the 1st day of life were both significant risk factors for late onset hyperbilirubinemia. [14]

In our study history of jaundice in previous siblings was noted in 15 (9.3%) cases. Family history of jaundice was noted in 14(8.6%) of study population. Study done by Najib et al found similar findings.[15] In the current study, urinary tract infection was

found in 2 (1.2%) cases and bruise was found in 3 (1.9%) study populations. Study done by Newman et al found bruise in 62 (0.13%) of study population but the study population was large in that study. [16]

In the current study clinical estimation of total serum bilirubin by visual assessment had a positive correlation with actual laboratory total serum bilirubin levels (pearson"s correlation coefficient= 0.837, $p < 0.0001$). These findings were similar to study by Riskin et al in which clinical estimation of serum total bilirubin done at 2nd day to 6th day of life had a higher correlation to actual serum bilirubin levels (pearson's correlation coefficient= 0.682 ,P< 0.001).[17] The similar findings in both these studies may be due to comparable age of presentation. In this study 56.17% study population presented in 2nd to 7 day of life. Study done by Madlon et al also showed that estimates of serum bilirubin were most highly correlated with serum bilirubin levels(Pearson correlation =0.61). The size of study population was 164 and mean age of presentation was 6.4 days of life.[18] In our study, the size of study population was 162, with mean age of presentation at 7.88 days. When we compared our study with other studies,we found that the visual assessment of the hyperbilirubinemia was positively correlated with the serum total bilirubin.[17,18]These findings could be similar because of visual estimation done by experienced observer working in children's hospital. The observations were done only in daylight or well lit room in these studies. However the mean age of presentation in our hospital was late which may be due to lack of knowledge, poor economic condition and lack of transportation.

Visual estimation by Kramers rule might be a useful aid in those hospitals where accurate total serum bilirubin determination are dificult to obtain due to lack of resources. More over, this method will enable the careful observer to determine more objectively the extent of dermal icterus at a given point of time.

LIMITATIONS

Our study was conducted in small sample size (162) and over short period of time. In this study G6PD level of each neonate could not be done, as this test is not available in Nepal.Our study was conducted only in a single hospital by single observer and covered only limited catchment areas so that it may not represent the community as whole and Interobserver disagreement can be expected due to subjective nature of determining the line between jaundiced and non jaundiced skin.

CONCLUSION

Visual assessment of neontal jaundice can be a primary screening tool for neontatal hyperbilirubinemia. Using this method, only significantly jaundiced babies can be sent to laboratory for measurement of total serum bilirubin level. Visual estimation of jaundice is not meant to replace measurement of total serum bilirubin, but it might be helpful in those peripheral hospitals where serum bilirubin measurement are not readily available, so that early institution of therapy is possible without waiting for laboratory confirmation. This method also helps primary health care workers for early diagnosis and timely referral to higher centres for either phototherapy or exchange transfusion therapy. This clinical approach of screening and evaluating neonatal hyperbilirubinemia is medically reasonable and saves both time and money, reduces parental anxiety and avoids frequent pricks to obtain blood for laboratory purposes.

RECOMMENDATION

A large-scale study with large sample size needs to be repeated in different centres by mutliple observers of Nepal to confirm the findings of the present study

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