International Journal of Medical and Health Research
ISSN: 2454-9142
www.medicalsciencejournal.com
Volume 1; Issue 5; December 2015; Page No. 14-17

Comparative study serum and cutaneous total bilirubin among newborns with hyperbilirubinemia in Khartoum estate

[1] Isam ahmed sadik, [2] Mashaer Abidlqader, [3] Nazra sayed osman, [4] Nagah Abd elwahab Mohammed, [5] mohmed abid alhmeed, [6] Nahla Mohammed Elzaki

[1] Phd, (Clin Biochemist) Associate Professor of Clinical Biochemistry at Omdurman Islamic University

[2] MD, (Pediatrician) Consultant Pediatrician at Neelain University

[3] MD, (Pediatrician) Consultant Pediatrician at Turkey Hospital Khartoum

[4] Phd, (Clin Biochemist) Associate Professor of Clinical Biochemistry at Sudan University of Science and Technology

[5] MD Pathologist Associate Professor of Pathology at Omdurman Islamic university

[6] Pediatric Specialist Ministry of Health Sudan

Abstract
The standard methods used in measuring serum bilirubin require blood specimen taken by heel pricks or intravenous blood sampling but transcutanse bilirubin is new method for measuring bilirubin in neonate. So this study was conducted to compare the estimates of serum bilirubin using a recently introduced device called (MBJ20), which is transcutaneous bilirubinometer (TCB) index with the standard direct spectrophotometric measurement of Total serum bilirubin (TSB). This is cross-sectional study was conducted in neonatal intensive care unit at Soba University Hospital, one hundred and fifty three, newborns with hyperbilibrubina were enrolled, Both TSB and, TCB reading were evaluated.
According to the date of jaundice onset 91.9% developed jaundice during period of 2-7 days, 5.9% in the first day and 2.6% after a week. TSB level among jaundiced neonates Less than 12 mg/dL was found in (29.4%), 12 – 2 mg/dL were detected in (67.9%), and More than 20 mg/dL was recorded in (2.6%). While, TCB level less that 12 mg/dL found in (20.9%), 12 – 2 mg/dL detected in (77.1%) and More than 20 mg/dL cited for (1.9%). At P≤0.05 there were no significant differences in TSB and TCB before phototherapy with Mean (13.40±2.83, 13.49±3.00) mg/dL for TSB and TCB respectively (P value .539). And after photo therapy Mean of TSB and TCB index were (13.00 ±4.40, 13.06±2.57) mg/dL respectively (P value0.769). Neonatal birth weight showed extremely low birth (2.6%), low birth weight in (54.9%), normal weight (37.3%) and Macrosomic (5.2%). The Gestational age of jaundiced neonates showed pre term (48.4%), Term (49%) and Post-term (2.6%). The study revealed that TCB was accurate method, as TSB before and after phototherapy. No difference when TCB was used for measuring TSB in term or preterm babies. So TCB device could be used in every Nursery as reliable.

Keywords: Sudan, bilirubin, neonates, TSB, TCB

Introduction

Hyperbiliburinemia is a common condition in newborn affecting over 50-60% of all babies, and about 50% of term baby and 80% of preterm babies developed jaundice in the first week of life.
(Smits-Wintjens, *et al*., 2008) [22]. It is a common phenomenon but relatively few affected infants require intervention. Whatever the cause, total serum bilirubin (TSB) levels above defined thresholds warrant treatment to prevent the development of kernicterus (Wong, *et al*., 2002) [18] Neonatal jaundice is a yellowing of the skin and sclera of the newborn infant, a bilirubin level of more than 85umol (5mg/dl) (Facchini, *et al*., 2007) [7]. Delay of management leads to serious central nervous system complications like kernicterus and acute bilirubin encephalopathy. However, the preventability of these complications has led to recommendations to screen all neonates for hyperbilirubinemia (Maisels, 1993 & Johnson, *et al*., 2002 & Chung, *et al*., 2004 & Kolman, *et al*., 2007 & Facchini, *et al*., 2007) [10, 5, 12, 7].
Phototherapy is the primary treatment in neonates with unconjugated hyperbilirubinemia. It is a common treatment in neonatal medicine and is used to prevent the neurotoxic effects of bilirubin. Studies have assessed the optimal wavelength of phototherapy light, the importance of irradiance and spectral power, and the types of light source, including the use of single versus multiple light sources. Outcome measures have been duration of need for phototherapy or rate of reduction of serum bilirubin over a given time (Ruud, 2010& Robert *et al*., 2010) [20, 19].
The standard methods used in measuring serum bilirubin require blood specimen taken by heel pricks or intravenous blood sampling, which involves pain of the newborn, and it is time consuming. A none invasive transcutaneous measurement of bilirubin concentration is developed to be an alternative

method reliable to detect hyperbilirubinemia, and by this new method, and through it, addition to (TSB) reached the etiological factors of neonatal jaundice, methods of management and short term outcome (Panburana, *et al.,* 2010) [15].

Neonatal Transcutaneous Jaundice meter MBJ20 (TCB) is a handhold instrument used in the dynamic clinical examination of neonate jaundice. It non-invasively and instantly tests transcutaneous concentration of bilirubin correlative with serum bilirubin concentration. It prevents the neonates from any discomfort brought by blood drawing. Moreover, it reduces test cost, increases the working efficiency of clinicians and nurses, decrease hazard, prevent parents' anxiety, early detection and rapid start of management. Since TCB required relatively lower thresholds with false-positive results for having a sensitivity of 100%, it cannot be recommended as a complete substitute for serum bilirubin measurements (Tan, *et al*., 2003) [28].

Although Jaundice is one of the common problems among neonates worldwide, no similar studies were conducted in Sudan, which necessitate assessing such problem in Sudan. Identifying neonatal jaundice will help verification for the disease aspects. We can make use of the fact that most of causes are preventable, most of short term outcomes can be detected earlier and treatable and the recent method for measuring serum bilirubin by Transcutaneous bilirubinometer (TCB)will provide early detection of jaundice and helps quick action of treatment. So this study conducted to compare bilirubin level using a recently introduced device called (MBJ20),its transcutaneous bilirubin index with the standard serum bilirubin assessment before and after phototherapy in addition to detect neonatal weight, term and gestation period in susceptibility to hyperbiliribunemia.

Material and Method

Study population

This study was conducted in neonatal intensive care unit (NICU) at Soba university hospital. One hundred and fifty three neonates, who had been admitted to intensive care unit (NICU), with clinical neonatal Jaundice, or who developed Jaundice later during period of admission at (NICU) were considered as study samples.

Data was collected during 1st of April to the August 2014.

Ethical consideration

This study was performed after approval by Sudanese Board of Medical Specialties participating in the hospital. Informed consent was obtained from mothers before collection of blood from newborns.

Samples processing

Blood samples were obtained from neonates collected into heparin-containing, containers. The samples were immediately sent to the hospital laboratory, where the plasma was separated and then immediately assayed for bilirubin by a diazomethod in an AU640 analyzer (Olympus).

The transcutaneous bilirubinometer (± 30) minutes for measuring bilirubin level, (TcB) measurement were performed over forehead.

Technique of use of MBJ 20 (TcB)

This is hand held, portable and rechargeable when pressure is applied to the photoprobe, a xenon tube generates a trobe light, and this light passes through the subcutaneous tissue. The reflected light returns through the second fiber optic bundle to the spectrophotometric module. The intensity of the yellow color in this light, after correcting for the hemoglobin, is measure and instantly displayed in arbitrary units.

Tools

Data collected through questionnaire, investigation and diagnosis, management and outcome.

Statistical Analysis

The data was analyzed using Statistical Package for Social Sciences (SPSS), Windows version8x, 1997 SPSS, Inc, Chicago, IL, and USA.

Student's ''t'' test was used to assess the significance percentage was also calculated.

Results

Classification according to the date of onset of jaundice revealed 91.9% developed jaundice during period of 2-7 days, 5.9% in the first day and 2.6% after day a week (Table 1).

Table 1: Onset of jaundice

Days	First day	2-7 days	Greater than 7 days
Percentage	5.9	91.5	2.6

Serum total bilirubin level among jaundiced neonates Less than 12 mg/dL was found in (29.4%),12 – 2 mg/dL were detected in (67.9%),and More than 20 mg/dL was recorded in (2.6%).While, Total Cutaneous Bilirubin less that 12 mg/dL found in (20.9%),12 – 2 mg/dL detected in(77.1%) and More than 20 mg/dL cited for(1.9%)(Tables 2,3).

Table 2: Serum total bilirubin Level among jaundiced neonates

	Frequency	Percent
Less than 12 mg/dL	45	29.4%
12 – 20 mg/dL	104	67.9%
More than 20 mg/dL	4	2.6%

Table 3: Total Cutaneous Bilirubin level among jaundiced neonates

	Frequency	Percent
Less than 12 mg/dL	32	20.9%
12 – 20 mg/dL	118	77.1%
Greater than 20 mg/dL	13	1.9%

At P≤0.05 there were no significant differences in total serum bilirubin (TSB) and total cutaneous bilirubin (TCB) before and after phototherapy. Mean of serum total bilirubin, and total cutaneous bilirubin index were (13.40±2.83, 13.49±3.00) mg/dL respectively (P value .539). And after photo therapy Mean of TSB and TCB index were (13.00 ±4.40, 13.06±2.57) mg/dL respectively (P value0.769) (Table 4).

Table 4: Total serum and cutaneous bilirubin before and after photo therapy

	Mean±SD	P value
First TSB	13.40±2.83	0.539
First TCB	13.49±3.00	
Second TSB	13.00±4.40	0.769
Second TCB	13.06±2.57`	

Neonatal birth weight showed extremely low birth (2.6%), low birth weight in (54.9%), normal weight (37.3%) and Macrosomic (5.2%).The Gestational age of jaundiced neonates showed pre term (48.4%), Term (49%) and Post-term (2.6%) (Tables 5, 6).

Table 5: Neonates birth weight

Birth weight	Number	Percentage
Extremely low birth(less than 1 kg)	4	2.6
Low birth (1 - 2.5 kg)	84	54.9
Normal (2.5 - 4 kg)	57	37.3
Macrosomic (greater than 4Kg)	8	5.2

Table 6: Gestational term

Gestational period	Number	Percentage
Preterm (less than 37 weeks)	74	48.4
Term(37-42 weeks)	75	49
Post term (greater than 42 weeks)	4	2.6

Discussion

In this study hyperbilirubiemia is more predominates among low birth neonates. This supported by study done by Korejo, *et al*., (2011) [3] & Martínez-Cruz, *et al*., (2008) [14] & Bus Korejo, (2012) who reported that low birth weight was risk factor for neonatal hyperbilirubinemia.

Total serum and cutaneous bilirubin before and after phototherapy showed no significant difference these results were in same line to that reported by Janj and Tans (2005) [9] who mentioned non significance of such relationship between TSB and TCB. Thus, the recent TCB method is reliable to be a diagnostic method of hyperbilirubinamia in neonates. It helps early detection of neonatal hyperbilirubnemia, early start management. Decrease the period of staying at hospital. The obtained results provide the opportunity to use this recent method (TCB) in both term and preterm neonate. Also this result supported by the study done by Yasuda in (2003) [17] & Samar, *et al.,* (2009) [21] who recommend TCB as accurate method, in term and preterm.

Transcutaneous bilirubinometer (TCB) could be used not only as a screening device but also as a reliable substitute of TSB determination. At higher levels of TSB, in which phototherapy might be considered, TCB performed slightly better than the laboratory. The accuracy and precision of the TCB measurement is comparable to the standard of care laboratory test. Janjindamai, *et al.,* (2005) [9] & Charuruks *et al*., 2005 [4] & Maisels, *et al.,* 2004) [13]. Other studies found that there is close correlation between TSB and TCB measurement David, *et al.,* 2005 [5]. Panburana, *et al.,* (2010) [15] found that the TCB levels can accurately predict TSB with the different cutoff points at various postnatal ages before phototherapy Felc (2005) [8] & Zecca, *et al*., (2010). So there is improvement of conventional transcutaneous bilirubinoetery gives results almost identical to those of bilirubin determination by the laboratory method.

Concerning skin bilirubin measurement during phototherapy in preterm and term newborn infants, it was found that the difference between TSB and TCB was 0.2 (not significant). This

Statistical result showed a good agreement between TSB and TCB. Also it can be safely used for the evaluation of bilirubin levels in newborn infants under phototherapy. Its reliability on patched skin of the forehead is high enough to consistently reduce blood draws and to ascertain when to discontinue phototherapy. Because of the individual variance, any clinical decision has to be taken on the basis of the transcutaneous bilirubin trend more than on a single value Stillova, *et al*., 2009 [24]. Slusher, (2007) [26]. In Africans newborn TCB measurements are a useful and reliable index for estimating STB levels in pigmented neonates, including those with hyperbilirubinemia and kernicterus. In the absence of reliable TSB measurements, the relatively simple and noninvasive TCB measurements can be an important adjunct in directing phototherapy and exchange transfusions, thereby preventing bilirubin-induced morbidity and mortality in low-technology clinical environments Tan, (2003) [28].

The prevalence of neonatal jaundice was high among preterm neonates. This supported by study done by Brouillard, (2003) [2] who reported Infants, especially preterm infants, have higher rates of bilirubin production than adults, because they have red cells with a higher turnover and a shorter life span. Together, these limitations lead to physiologic jaundice-that is, high serum bilirubin concentrations in the first days of life in full-term infants (and up to the first week in preterm infants and in some full-term Asian infants), followed by a decline during the next several weeks to the values commonly found in adults. The average full-term newborn infant has a peak serum bilirubin concentration of 5 to 6 mg per deciliter (86 to 103 μmol per liter).

Conclusion

There is no variance found in bilirubin level either by using blood sampling or transcutaneously by MBJ20 device. Term and neonates weight play major role in susceptibility to neonatal jaundice.

Recommendations

Furthermore, studies should do with large samples size longitudinal study to give best results more than cross-sectional study.

References

1. Agarwal V, Singh SP, Goel B. Gupta. Maternal and Neonatal Factors Affecting Physiological Jaundice in Western U.P. V. Agarwal, Department of Physiology, Lala Lajpat Rai Memorial Medical College. Indian J Physiol Pharmacol. 2007; 51(2):203-206.
2. Brouillard R. Measurement of red blood cell life-span. JAMA Proc Natl Acad Sci USA. April 2003; 1100(7):4156-4161.
3. Bus Korejo H, Bhurgri Hr, Qureshi Ma, Frazana Sheikh, Mustafa Dahri M, Chohan Rk. Etiology of Neonatal Jaundice an Experience at Tertiary Hospital. MC. 2011; 17(2):53-56.
4. Charuruks N, Milintagas A. Evaluation of Calculated Low-density Lipoprotein against a Direct Assay. J Med Assoc. Thai 2005; 88(2):187-90.
5. Chung Kulig M. An evidence-based review of important issues concerning neonatal hyperbilirubinemia. Pediatrics 2004; 114:130-53.
6. David Stevensona K, Ronald Wong J, Hendrik Vreman J. Reduction in Hospital Readmission Rates for Hyperbilirubinemia Is Associated with Use of Transcutaneous Bilirubin Measurements. American

Association for Clinical Chemistry, Inc. Clinical Chemistry; 2005; 51:481-482.
7. Facchini FP, Mezzacappa MA. Follow up of neonatal jaundice in term and late preterm neoborn. Universidaade E s stadual de companies (UN ICAMP)-companies, sp, Brazil. JPediatr (Rioj), 2 Jul-August 2007; 83(4):313-22.
8. Felc Z. Improvement of conventional transcutaneous bilirubinometry results in term newborn infants. 2005; 22(4):173-9.
9. Janjindamai W, Tansantiwong T. Accuracy of transcutaneous bilirubinometer estimates using Bilicheck in Thai neonates. J Med Assoc Thai. 2005; 88(2):187-90.
10. Johnson LH, Bhutani VK. System-based approach to management of neonatal jaundice and prevention of kernicterus. Pediatrics. 2002; 140:393-403.
11. Karyn B. Kolman MD, Kathleen M, Mathieson Frias C. A Comparison of Transcutaneous and Total Serum Bilirubin in Newborn Hispanic Infants at 35 or More Weeks of Gestation. Am Academy of Pediatr. 2001; 107(6):1264-1271.
12. Kolman B, Mathieson M, Frias C. A Comparison of Transcutaneous and Total Serum Bilirubin in Newborn Hispanic Infants at 35 or More Weeks of Gestation, J Am Board Fam Med. 2007; (20):266-271.
13. Maisels MJ, Ostrea EM Jr, Touch S, Clune SE, Cepeda E, Kring E *et al.* Neonatal Hyperbilirubinemia, Kernicterus and Non-Invasive Bilirubin Measurements. 2004; 113(6):1628-35.
14. Martínez-Cruz CF, Poblano A, Fernández-Carrocera LA. Infants at the Neonatal Intensive Care Unit: 15-Year Experience at the National Institute of Perinatology (Mexico City). October 2008; 39(7):686-694.
15. Panburana J, Boonkasidach S, Rearkyai S. Accuracy of transcutaneous bilirubinometry compare to total serum bilirubin measurementBangkok, Thailand. Feb; 93 Suppl 2010; 2:S81-6.
16. Prechapanich J, Tongtub E. Retrospective review of the relationship between parity and pregnancy outcomes at Siriraj Hospital. Mendley. 2010; 62(1):14-19
17. Yasuda S, Itoh S, Isobe K, Yonetani M, Nakamura H, Nakamura M *et al.* New transcutaneous jaundice device with two optical paths J Perinat Med. 2003; 31(1):81-8.
18. Wong MC, Dijk PJ, laing IA. A comparison of transcutaneous bilirubinometers: SpectRx BiliCheck versus Minolta Air Shields, Arch Dis Child FetalNeonatal; 2002; (87):137-140. www.dotmed.com
19. Robert M, Kliegman MD, Bonita MD, Stanton MD, Joseph ST, Geme Nina Schor *et al.* Behrman, MD. Nelson Textbook of Pediatrics, 19th Ed, 2010, 753.
20. Ruud Hansen TW. Phototherapy for neonatal jaundice, therapeutic effects on more than one level? Semin Perinatol. 2010; 34(3):231-4.
21. Samar El-Beshbishi1 N, Karen Shattuck E, Amin Mohammad A, John Petersen R. Hyperbilirubinemia and Transcutaneous Bilirubinometry. J of Clinical Chemistry. 2009; 3(55):1280-1287.
22. Smits-Wintjens VE, Walther FJ, Lopriore E. Rhesus ISO Immunization risk factors of severe hyperbilirubinemia. Department of Paediatrics, Division of Neonatology. Epub 2008; 13(4):265-71.
23. Stillova L, Matasova K, Mikitova T, Stilla J, Kolarovszka H, Zibolen M. Evaluation of transcutaneous bilirubinometry in preterm infants of gestational age 32-34 weeks. Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub. 2007; 151(2):267-71.
24. Stillova L, Matasova K, Zibolen M, Stilla J, Kolarovszka H. Transcutaneous Bilirubinometry in Preterm Neonates. 2009; (46):405-8.
25. Stoniene D, Buinauskiene J, Markūniene E. The value of transcutaneous method of bilirubin measurement in newborn population with the risk of ABO hemolytic disease. Medicina (Kaunas); 2009; 45(10):792-7.
26. Slusher TM, Angyo IA, Bode-Thomas F, Akor F, Pam SD, Adetunji AA *et al.* A Comparison of Transcutaneous and Total Serum Bilirubin in Newborn Hispanic Infants at 35 or More Weeks of Gestation. The Journal of the American Board of Family Medicine. 2007; 20(3):266-271.
27. Stoniene D, Buinauskiene J, Markūniene E. The value of transcutaneous method of bilirubin measurement in newborn population with the risk of ABO hemolytic disease. Medicina (Kaunas). 2009; 45(10):792-7.
28. Tan KL, Dong F. Transcutaneous bilirubinometry during and after phototherapy. Acta Paediatr 2003; 92:327-331.
29. Zecca E, Barone G, De Luca D, Marra R, Tiberi E, Romagnoli C. Skin bilirubin measurement during phototherapy in preterm and term newborn infants. Italy. Early Hum Dev. 2009; 85(8):537-40.