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Comparison Study between Serum and Transcutaneous Bilirubin Measurement with Special Reference to Gestational Age

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Abstract: ***Objective: To compare blirubin level of transcutaneous bilirubinometer with serum blirubin in term and pre-term newborn. Methods : This prospective analytic study were carried out at NICU of tertiary care center from May to September 2014, which include total 410 neonates (250 term & 180 preterm neonates) during the study period. Simultaneous plasma and transcutaneous (sternal regions) bilirubin assay were performed in term and pre-term newborns. Neonates were divided in 3 groups according to their gestational age, group-1 (28wk-33 wk), group-2(34wk-37wk) and group-3 (38wk -41wk). Results : There were strong correlation between plasma and mean transcutaneous blirubin assay measured in sternal region in group-3 newborn (CV=0.49, r=0.8599, p<0.001). There were no correlation between plasma and transcutaneous blirubin in group-1(CV=0.15,r=0.3450,p>0.001) and group-2 (CV=0.18,r=0.4521,p>0.001) suggestive of wide variation in transcutaneous blirubin value & serum blirubin value. Conclusion: In pre-term newborn transcutaneous bilirubinometry is less accurate than in term newborns,as results are affected by the immature skin and by a different albumin-to-bilirubin binding.***

1. Introduction

The incidence of hyperbilirubinemia has been reported to be between 30-60% in full term newborn and nearly 100% in premature infants[(1).] The accurate measurement of bilirubin concentrations is essential for diagnosis of hyperbilirubinemia and for guiding the clinician with regard to treatment. The gold standard remains the measurement of serum bilirubin concentration. This method however is invasive, painful and costly in terms of workload, time &money. Moreover, repeated blood samplings may lead to significant blood loss, which may be of particular concern in preterm infants. Hyperbilirubinemia during neonatal period is generally benign,but due to the potential toxicity of bilirubin,newborn infants who are at risk of developing significant hyperbilirubinemia should always be monitored in order to prevent complication of neonatal hyperbilirubinemia like blirubin encephalopathy. bilirubinometry has been shown to correlate with serum serum blirubin concentration in term infants[(2-8)].In preterm infants transcutaneous bilirubinometry is less accurate than in term infants,as results are affected by the immature skin and by a different albumin to blirubin binding.[(6,9,10)]

2. Materials & Methods

The study was carried out in the neonatal intensive care unit of civil hospital, Ahmedabad, during the period over 6 months (May 2014 to September 2014). Study include 410 neonates admitted during the same period, out of which 250 were term neonates and 160 preterm neonates. Inclusion criteria : (1)Neonates between 28 wk to 41 wk admitted in NICU with indirect hyperbilirubinemia.

Exclusion criteria
(1)Neonates with direct hyperbilirubinemia.
(2)Post term neonate (>42wk)

The study was approved by the local ethics committee, and parental consent was obtained. For the study, transcutaneous blirubin was measured by transcutaneous bilirubinometer over the sternal area & mean of the three reading was considered & level is displayed in mg/dl.This was done within 15 minutes after the blood sampling & serum blirubin was performed by Diazo method.

For analysis, the mean of three transcutaneous blirubin readings was taken and compared with the serum blirubin concentration. The coefficient of variation (CV) of these three measurement was calculated for three group. The relationship between transcutaneous and serum blirubin values was determined using simple linear regression analysis. The strength of this relationship was quantified by using the Pearson correlation coefficient r. The agreement between both methods was assessed by the method of Bland-Altman. A multiple linear regression analysis was performed to identify confounders to predict serum bilirubin.

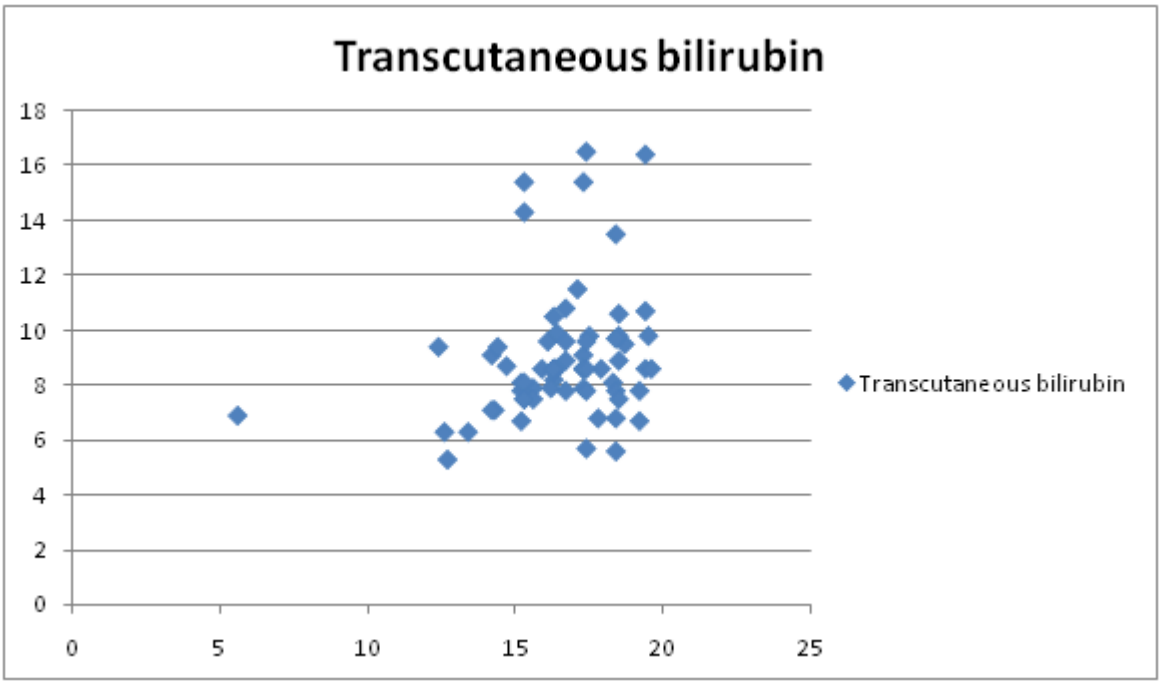
3. Results

A total 180 preterm and 250 term neonates were included in study, The group of preterm infants was subdivided into premature neonates between 28 and 33 weeks of gestation (group 1) and premature infants between 34 and 37 week of gestation (group 2).The term neonates between 37 week and 41weeks of gestation (group 3).
The relationship between serum blirubin concentration and transcutaneous blirubin concentration for gestational age group 3 was y=0.50x + 77 ,for group2 was Y=0.40x + 110 & group 1 was y=0.36x+115. The relationship for all term infants (y=250,y=0.50x+77,R^2 =0.49; P <0.01).For group-1 (y=70; y=0.36x+115,R^2=0.15;P>0.001) & For group-2 (Y=110,y=0.40x+110,R^2=0.18;p>0.001).

Groups	*Mean Transcutaneous Bilirubin(mg/dl)*	*Serum Bilirubin (mg/dl)*	*Coefficient Variation (CV)*	*Correlation coefficient*	*P value*
Group-1 (28wk-33wk)	9.6±1.9 mg/dl	14.6±2.1 mg/dl	R^2=0.15	r=0.3450	p>0.001
Group-2 (34wk-37wk)	10.4±1.6 mg/dl	13.7±2.3 mg/dl	R^2=0.18	r=0.4521	p>0.001
Group-3 (38wk-41wk)	15.6±2.3 mg/dl	16.6±2.9 mg/dl	R^2=0.49	r=0.8599	P<0.001

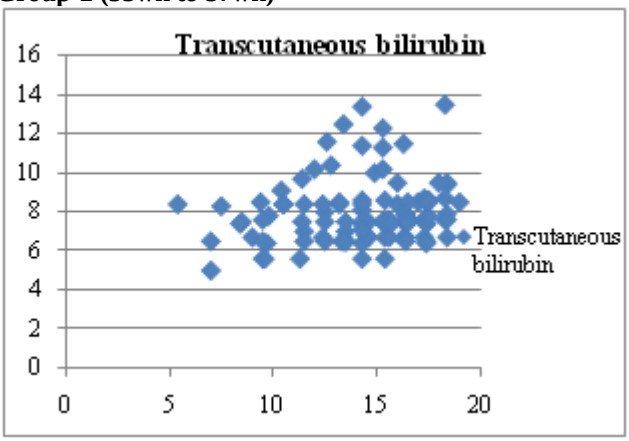
Comparing the regression equation of all preterm infants with the term group,the constant for the preterm infants was greater than for term infants .The coefficient variation R^2 (0.15) and Correlation coefficient(r=0.3450) showed a worse agreement for preterm than for term infants.

Group 1 (28wk to 33wk)



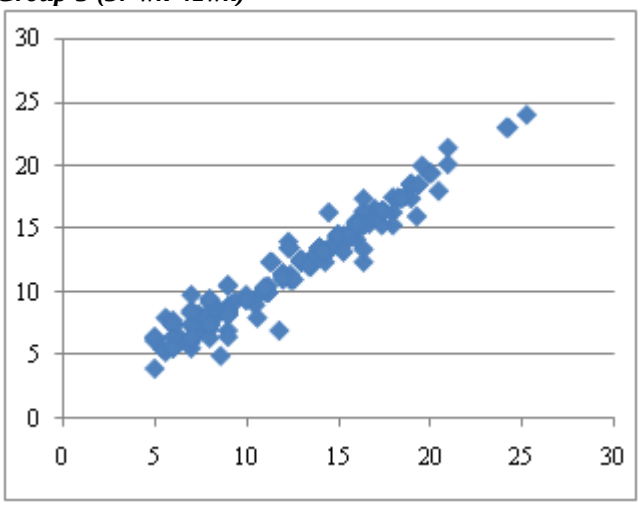
X-axis :Serum blirubin.
Y-axis :Transcutaneous blirubin.

Group-2 (33wk to 37wk)



X-axis :Serum blirubin.
Y-axis :Transcutaneous blirubin.

Group-3 (37 wk-41wk)



X-axis: Serum Bilirubin.
Y-axis: Transcutaneous blirubin.

4. Discussion

Principal mechanism of TCB is, when Light passes through inbuilt fiberoptics and reflectometer and is analzed by

computerized spectro photometer to provide immediate digital display of total blirubin[16].

Transcutaneous blirubin (TcB) determination has become a valuable aid in avoiding significant neonatal hyperbilirubinemia [19] and has significantly reduced the number of heel stick blood samplings and their complications [20]. Severe hyperbilirubinemia (kernicterus and, irreversible neurological sequelae) in newborns is preventable through appropriate follow-up, diagnosis, and treatment, such as phototherapy and exchange transfusions. Neonatal jaundice is more prevalent in the Asian population, which may lead to a higher risk of developing kernicterus.

TCB is reliable method in term babies for blirubin monitoring as good correlation was observed between transcutaneous & serum blirubin values while TCB is unreliable in preterm because immaturity of skin & low albumin to blirubin binding.Study do not confer correlation between transcutaneous blirubin measurement and plasma bilirubin concentration in preterm infants.

The preterm infants in present study were divided into two group 28wk to 33wk (Group-1) & 34wk to 37wk (Group-2),the reason for sub dividing this group was that the most very premature infants clinically clearly represented a separate group by being sicker or needing support (eg,parenteral feeding,coffein,oxygen etc) and thereby,in addition to younger gestational age were at higher risk for blirubin encephalopathy.

In present study,there was strong correlation between transcutaneous bilirubin and serum bilirubin in term baby with coefficient variation R^2=0.49,coefficient correlation r=0.8599 & P<0.001,while there was poor correlation between transcutaneous blirubin and serum blirubin in preterm baby with coefficient variation R^2=0.15,coefficient correlation r=0.3450 & P>0.001 for group-1 (28wk-31wk) & coefficient variation R^2=0.18,coefficient correlation r=0.4521 & P>0.001 for group-2 (34wk-37wk).

Study carried by Mahajan G,Kaushal RK,Sanchayan N found same findings with strong correlation in term value with coefficient variation R^2=0.53,coefficient correlation r=0.8319 & P<0.001 & poor correlation found between transcutaneous blirubin and serum blirubin in preterm baby with R^2=0.17, r=0.3120 & P>0.001[18].

Similar study carried by Mishra S,Chawda D,Agawal R ,there was strong correlation between transcutaneous blirubin and serum blirubin in term neonate. Study do not confer correlation between transcutaneous blirubin measurement and plasma blirubin concentration in preterm infants, as result are affected by the immature skin and a different albumin to blirubin binding[17].Gronmann K,Roser M,Rolinski B also conferred similar finding with poor correlation between serum blirubin and transcutaneous bilirubin in preterm infant due to immaturity of skin as compare to term infants[12].

It has been shown that the accuracy of measurements decreases when performed by several investigators,we took care that all measurements were performed by one person always over the infant's sternum[11,13,15]. Choosing the sternum as sampling site is due to large measurement area of the bilicheck instrument making measurement over the forehead more difficult,especially when studying more premature infant due to their smaller size or to nasal CPAP bonnet.

5. Conclusion

In pre-term newborn transcutaneous bilirubinometry is less accurate than in term newborns,as results are affected by the immature skin and by a different albumin-to-blirubin binding,while TCB can be used as non-invasive ,painless & reliable method for blirubin measurement in term newborn as it is comparable to serum blirubin.

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