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Original article

Early predictive value of cord blood bilirubin and dynamic monitoring of transcutaneous bilirubin for hyperbilirubinemia of newborns

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ABSTRACT

Objective: To study the early predictive value of cord blood bilirubin and dynamic monitoring of transcutaneous bilirubin for hyperbilirubinemia of newborns.
Methods: 389 newborns delivered from June 2014 to December 2015 were enrolled as the research subjects; detailed records were made about the general data of newborns and mothers, and after cord blood bilirubin being graded, the incidence of hyperbilirubinemia was counted, and the prediction efficiency of cord blood bilirubin was analyzed by receiver operator characteristic (ROC) curve. At the same time, the transcutaneous bilirubin was detected continuously when the neonate was born and 24 h, 48 h and 72 h after birth, and the relativity between transcutaneous bilirubin at 72 h and serum bilirubin was analyzed.
Results: No significant difference was found in the hyperbilirubinemia group and the non-hyperbilirubinemia group concerning general data of the newborns and their mothers. With the concentration of cord blood bilirubin increased, the incidence of hyperbilirubinemia also increased; separate prediction of hyperbilirubinemia by cord blood bilirubin showed a sensitivity and specificity of 71.4% and 65.6% respectively, and they need further dynamic monitoring. The daily mean of transcutaneous bilirubin in hyperbilirubinemia group was significantly higher than that in non-hyperbilirubinemia group at 24 h, 48 h and 72 h, and the measurement value of transcutaneous bilirubin at 72 h had a high correlation with serum bilirubin. When transcutaneous bilirubin value is higher than 18, the incidence of hyperbilirubinemia should be considered.
Conclusions: The increase of cord blood bilirubin effectively predict the occurrence of neonatal hyperbilirubinemia. There is a good correlation between levels of transcutaneous bilirubin and serum bilirubin. Moreover, combined detection of transcutaneous bilirubin and cord blood bilirubin can significantly improve the prediction accuracy of hyperbilirubinemia.

1. Introduction

Neonatal hyperbilirubinemia is one of the common symptoms available during neonatal period. Bilirubin metabolism in adults and newborns is not the same, and the golden standard to evaluate neonatal hyperbilirubinemia is the concentration of total serum bilirubin (TSB). If the concentration of serum bilirubin in adults was higher than 2 mg/dL, there would be yellowish pigmentation of skin and sclera; in case the newborns had a wealth of capillaries, when the concentration of serum bilirubin was higher than 5 mg/dL, their skin would show visible yellow (Huang and Guan, 2012). With the development of bilirubin measurement instrument, coupled with the advantages of simple operation and being painless, transcutaneous bilirubin is becoming widely used. Whereas for the measurement of serum bilirubin, venous or heel blood collection is necessary, which will bring stress and pain, even infection to the newborns, and repeated blood tests may also cause iatrogenic blood loss. Currently, transcutaneous bilirubin is more extensively used in the stepwise screen of hyperbilirubinemia, while TSB is less widely used (Nagar et al., 2013). In 1980, Yamanouchi et al. (1980) developed a light and portable device for the determination of hemoglobin. Transcutaneous bilirubin measurement can monitor neonatal jaundice continuously and dynamically, perform large-scale screening of neonatal hyperbilirubinemia and avoid measurement of serum bilirubin by skin

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puncture, which can not only reduce the newborns' pain, but also lessen the risk of infection without trauma, convenience, efficacy or simplicity. Affected by race, skin color and instrument error, however, clinical studies have shown there are certain limitations of Transcutaneous bilirubin measurement. As reported in literature (Persson et al., 2013) that the cord blood bilirubin (CBB) can predict hyperbilirubinemia early, which makes it earlier for doctors in terms of diagnosis and treatment. Through continuous study on neonatal hyperbilirubinemia, people have more in-depth understanding on the disease. Although partial causes of hyperbilirubinemia have not yet been clear, research has never been ceased and various methods will be used for early diagnosis and treatment of hyperbilirubinemia; furthermore, combined use of different treatment methods and emergence of new treatments will lead to rapid, safe and reliable treatment for neonatal hyperbilirubinemia (Li et al., 2005).

389 newborns were included as the research subjects and detailed records were made about the general data of the newborns and their mothers; moreover, the cord blood bilirubin, the transcutaneous bilirubin and the serum bilirubin were detected, and hyperbilirubinemia incidence in cord blood bilirubin and transcutaneous bilirubin with different concentrations were analyzed as well; furthermore, the diagnostic value of separate and combined detection of hyperbilirubinemia was evaluated through ROC curve. The study aimed at providing diagnostic basis for clinicians.

2. Materials and methods

2.1. Data source

389 newborns which were delivered during June 2014 and December 2015 were considered as the research subjects, and then detailed records were made about the characteristics of newborns and their mothers, which were listed in Tables 1 and 2. Inclusion criteria: newborns without diseases in heart, liver, kidney and other important organs; mothers without hepatobiliary diseases; Apgar scored higher than 8 points; informed consents were signed before this study was conducted.

2.2. Methods

2.2.1. Detection of the total cord blood bilirubin

When the neonatal umbilicus was cut after delivery, 2 mL umbilical venous blood was extracted immediately from the placental umbilical cord stump and was taken for examination. In order to avoid hemolysis, after the sample was sent to clinical laboratory, it should be promptly placed in water bath under the condition of 37 °C for 30 min; when the blood was fully solidified, it was placed in a centrifugal machine whose speed was 2000 turn/min to separate serum for 5 min, and then the serum was detected through Japanese Hitachi 7170A automatic biochemical analyzer.

Table 1
Neonatal characteristics.

Features	Type	Hyperbilirubinemia group (N(%))	Non-hyperbilirubinemia group (N(%))	χ^2	*p*
Gender	Male	50 (59.52)	160 (52.46)	1.32	0.25
	Female	34 (40.48)	145 (47.54)		
Gestational age/week	Preterm delivery (<35)	22 (26.19)	80 (26.23)	0.32	0.82
	Late preterm delivery (35–<37)	25 (29.76)	81 (26.56)		
	Full-term (≥37)	37 (44.05)	144 (47.21)		
Birth weight/g	<2500	7 (8.33)	25 (8.20)	0.14	0.93
	2500–<3000	19 (22.62)	75 (24.59)		
	≥3000	58 (69.05)	205 (67.21)		
Delivery mode	Natural birth	49 (58.34)	183 (60.00)	0.4	0.82
	Delivery through vaginas	7 (8.33)	30 (9.84)		
	Cesarean delivery	28 (33.33)	92 (30.16)		
Twins/triplets		9 (10.71)	25 (8.20)	0.52	0.47
Feeding/nutrition	Exclusive breast-feeding	25 (29.76)	69 (22.62)	5.32	0.15
	Artificial feeding	5 (5.95)	7 (2.30)		
	Breast-feeding and artificial feeding	53 (63.10)	224 (73.44)		
	Parenteral nutrition	1 (1.19)	5 (1.64)		
Blood type	A	27 (32.14)	113 (37.05)	3.15	0.37
	B	29 (34.52)	110 (36.07)		
	AB	7 (8.33)	31 (10.16)		
	O	21 (25.00)	51 (16.72)		
	Rh+	71 (84.52)	275 (90.16)	2.13	0.14

Table 2
Maternal characteristics.

Features	Type	Hyperbilirubinemia group (N(%))	Non-hyperbilirubinemia group (N(%))	χ^2	*p*
Age (during the period of delivery)/ years old	<25	25 (29.76)	75 (24.59)	0.95	0.62
	25～<35	49 (58.34)	193 (63.28)		
	≥35	10 (11.90)	37 (12.13)		
Firstborn (parity)		53 (63.10)	176 (57.70)	0.79	0.37
Blood type	A	29 (34.53)	118 (38.69)	4.93	0.18
	B	24 (28.57)	106 (34.75)		
	AB	5 (5.95)	21 (6.89)		
	O	26 (30.95)	60 (19.67)		
	Rh+	73 (86.90)	280 (91.80)	1.88	0.17