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Original Article

Exploration of the pathogenic factors of neonatal jaundice and the clinical effect of blue phototherapy

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Abstract: Objective: To study the pathogenic factors of neonatal jaundice and the clinical effect of blue light phototherapy. Methods: We selected 240 children with neonatal jaundice admitted to our hospital from January 2018 to January 2019 as the research subjects, and divided them into a control group and experimental group by a random grouping method, with 120 cases in each group. The control group received conventional treatment, and the experimental group received blue phototherapy. We observed the therapeutic effect on the two groups and analyzed the onset factors, compared the transcutaneous bilirubin value, serum bilirubin level, the time for the jaundice to subside after treatment, lactate dehydrogenase (LDH), creatine kinase (CK) in the myocardial enzyme spectrum, and alanine aminotransferase (ALT) and aspartate aminotransferase (AST) to show liver function. Results: Rate of effective treatment in the experimental group was higher than that in the control group. The transcutaneous bilirubin values and serum bilirubin levels of the two groups of children with jaundice were reduced after treatment ($P<0.001$), and the decrease in the experimental group after treatment was more notable ($P<0.001$). Jaundice subsided after treatment in the experimental group faster than in the control group ($P<0.001$). Children with jaundice in the experimental group had lower indexes of LDH, CK, ALT and AST compared with those of the control group ($P<0.05$). Conclusion: Phototherapy is a preferable method for neonatal jaundice and worthy of clinical application.

Keywords: Neonatal jaundice, etiology, blue phototherapy, clinical effect

Introduction

Jaundice is a particularly common disease in the newborn population. The increase in serum bile concentration caused by bilirubin metabolism disorder is the leading cause of jaundice, and the main manifestations are yellowing of the sclera and skin. If timely treatment is not provided, this will have a serious impact on the intelligence of the newborn [1-3]. Jaundice is classified into physiological jaundice and pathological jaundice. Physiological jaundice presents in about 3 days after the birth of a newborn, peaking at about 7 days, and it gradually disappears after 10 days. The physiological jaundice can subside on its own. The causes of pathological jaundice are relatively complicated, and breast milk jaundice and hemolytic jaundice result in jaundice.

According to the degree of yellowing, the severity of neonatal jaundice can be distinguished. Mild yellow means that yellowing only exhibits on the face of the newborn; moderate refers to that the yellowing on the trunk of the newborn; severe is yellowing that presents on the limbs and the hands palm, and feet arch, which requires hospitalization for examination and timely treatment [4-7].

Research on the physiological functions and toxicity of bilirubin shows that bilirubin has varying degrees of damage to the heart, liver, kidney, lung and other important organs, as well as blood and immune systems. Myocardial enzymes are distributed in the whole body tissues, especially in the heart, liver, lungs, skeletal muscle, kidney, and brain. The myocardial enzyme spectrum mainly includes creatine phosphokinase (CK), myokinase isoenzyme (CK-MB), aspartate aminotransferase (AST), and lactate dehydrogenase (LDH). When the cardiomyocytes have inflammation (myocarditis) or necrosis (myocardial infarction) due to various reasons, the enzymes contained in the cardiomyocytes can enter the blood, and the

Table 1. Comparison of general data of two groups of children with jaundice [n (%)]

	Control group (n=120)	Experimental group (n=120)	t/X^2	P
Gestational age (weeks)	39.27±0.53	39.24±0.49	0.455	0.649
BMI (kg/m^2)	3.23±0.32	3.26±0.41	0.631	0.528
G6PD deficiency	23 (19.16)	20 (16.66)	0.255	0.614
Breast feeding	25 (2.08)	22 (1.83)	0.238	0.626
Gender			2.020	0.155
Male	57 (47.5)	68 (56.66)		
Female	63 (52.5)	52 (43.33)		
Residence			1.748	0.186
Township	78 (65.00)	85 (70.83)		
Rural areas	42 (35.00)	35 (29.16)		

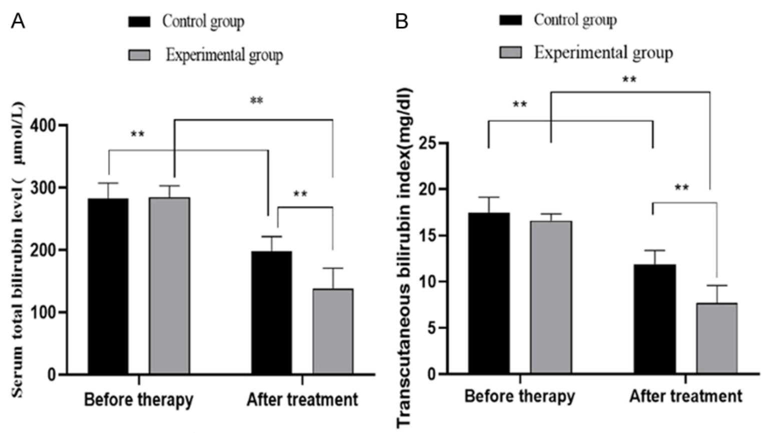

Figure 1. Comparison of serum total bilirubin levels and transcutaneous bilirubin index before and after treatment between the two groups. Note: A. The abscissa indicates before and after treatment, and the ordinate indicates the serum total bilirubin level (μmol/L). The serum total bilirubin levels of the control group before and after treatment were (265.68±34.26) μmol/L and (180.32±34.16) μmol/L, respectively. The serum total bilirubin levels before and after treatment in the experimental group were (271.36±26.00) μmol/L and (115.34±45.87) μmol/L. A significant difference in serum total bilirubin levels before and after treatment was seen in the control group (t=19.327, **P<0.01). The serum total bilirubin levels of jaundiced children in the experimental group were significantly different before and after treatment (t=32.414, **P<0.01). There was a significant difference in serum total bilirubin levels between the control group and the experimental group after treatment (t=12.446, **P<0.01). B. The abscissa represents before and after treatment, and the ordinate represents transcutaneous bilirubin index (mg/dl). The transcutaneous bilirubin index of the control group before and after treatment was (16.33±2.32) mg/dl and (10.87±2.09) mg/dl, respectively. The transcutaneous bilirubin index of the experimental group before and after treatment was (16.07±1.05) mg/dl, and (6.35±2.68) mg/dl. The transcutaneous bilirubin index of the control group was significantly different before and after treatment (t=19.154, **P<0.01). There was a significant difference in transcutaneous bilirubin index in the experimental group before and after treatment (t=36.992, **P<0.01). There was a significant difference in transcutaneous bilirubin index between the control group and the experimental group after treatment (t=17.202, **p<0.01).

activity (content) of these enzymes in the blood increases. At present, phototherapy of blue light is predominantly used for treatment of neonatal jaundice, and it can reduce the concentration of serum in newborns. Therefore, we further explored the pathogenic factors of neonatal jaundice and the clinical effects of blue phototherapy in this study.

Materials and methods

General information

The 240 children with jaundice admitted to our hospital from January 2018 to January 2019 were selected and divided into a control group and an experimental group according to the random grouping method, with 120 cases in each group. The control group received conventional treatment, and the experimental group received blue phototherapy. The control group had 57 male children and 63 female children; the average gestational age was (39.27±0.53) weeks. The experimental group had 68 male children and 52 female children; the average gestational age was (39.24±0.49) weeks. No significant difference was observed in clinical data between the two groups (P>0.05).

Inclusion criteria

① Patients who met the diagnostic criteria of neonatal jaundice; ② Patients with complete data; ③ This study was approved by the hospital ethics committee, and the child and his family knew the purpose and procedure of the study and signed an informed consent form.

Exclusion criteria

① With brain, heart, kidney, liver and other organ tissue diseases; ② With physical dis-

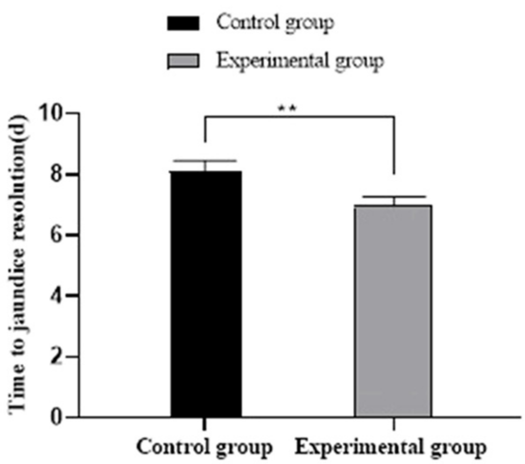

Figure 2. Jaundice disappearance time after treatment in the two groups (d). Note: The abscissa represents the control group and the experimental group, and the ordinate represents the jaundice disappearance time after treatment (d). In the control group, the disappearance time of jaundice after treatment was (7.83±0.51) days. The disappearance time of jaundice in the experimental group after treatment was (6.73±0.45) days. There was a significant difference in disappearance time of jaundice between the control group and the experimental group after treatment (t=17.716, **P<0.01).

abilities; ③ With drug allergy.

Methods

The control group was given conventional treatment. Warmth and nutritional supply was provided for children with jaundice to prevent developing clinical symptoms such as hypoxia and low temperature, and to prevent them from being infected. During the treatment process, children with jaundice were injected with albumin and given corresponding treatment in case of adverse reactions.

The experimental group was treated with blue light phototherapy. The infant phototherapy incubator was used, skin temperature was controlled at 26°C to 36°C±0.8°C; blue light wavelength of the phototherapy box was set at 400 to 550 nm, to avoid damage to the skin of children; baby cabin internal noise should be ≤45 db, and the humidity should be 20% RH to 90% RH; the exposed parts other than the sensitive parts of the baby such as eyes and reproductive organs should be irradiated with blue light, with a length of 7 h, 2 times/d; the interval time was 5 h, and the irradiation continued for 1 week.

Observation indicators

The transcutaneous bilirubin value and serum bilirubin level before and after treatment were detected; disappearance time of jaundice after treatment, the response of LDH and CK in the myocardial enzyme spectrum, and ALT and AST in liver function were recorded.

Statistical processing

The experimental data were all statistically analyzed and processed by SPSS21.0 software. Counted data were expressed in the form of [n (%)] and run by x^2 test; measured data were expressed as (x ± s) and conducted by t test. When P<0.05, the difference was considered significant. GraphPad Prism 8 software was used to plot the graphics.

Results

General information comparison

No marked difference was identified by comparing the gestational age, BMI, G6PD deficiency, breastfeeding, gender and place of residence between the two groups of children with jaundice (P>0.05). See **Table 1**.

Comparison of clinical efficacy

The serum total bilirubin level and transcutaneous bilirubin index of the two groups of children after treatment decreased notably compared with those before treatment (P<0.001), and the reduction of the experimental group was more significant compared with the control group (P<0.001), see **Figure 1A** and **1B**; in addition, the time in which jaundice subsided in the experimental group was faster than in the control group after treatment (P<0.001), see **Figure 2**; the indexes of LDH and CK in myocardial enzyme spectrum and ALT, AST for liver function were lower than those in the control group (P<0.05), as shown in **Figure 3A** and **3B**.

Discussion

In recent years, the incidence of neonatal jaundice has shown a rising trend. Both traditional Chinese medicine theory and Western medicine believe that poor digestive and circulatory functions and insufficient liver function are attributable to neonatal jaundice. Consequent-

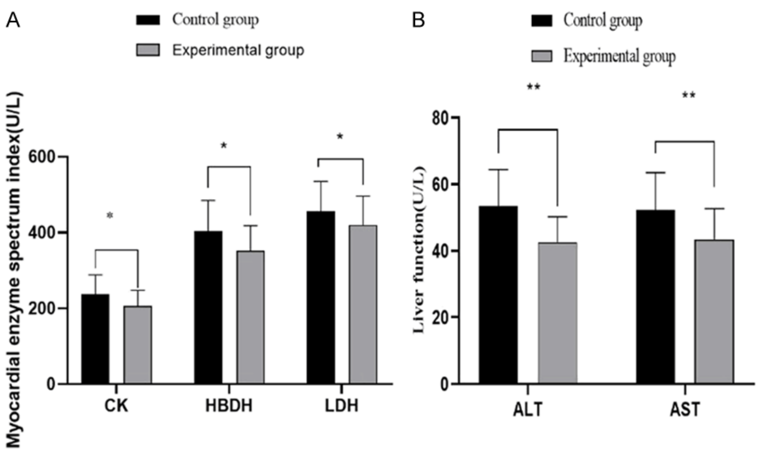

Figure 3. Comparison of myocardial enzyme spectrum indexes and liver function index levels after treatment (U/L). Note: A. The abscissa represents CK and LDH in the myocardial enzyme spectrum after treatment, and the ordinate represents the myocardial enzyme spectrum index (U/L). The CK and LDH of the jaundice children in the control group after treatment were (201.36±71.93) U/L and (401.36±111) U/L, respectively. The CK and LDH of children with jaundice in the experimental group after treatment were (176.39±59.3) U/L and (365.42±108.27) U/L, respectively. There was a significant difference in CK between the control group and the experimental group of children with jaundice after treatment (t=2.934, *P=0.0037). There was a significant difference in LDH between the control group and the experimental group of children with jaundice after treatment (t=2.539, *P=0.011). B. The abscissa represents ALT and AST after treatment, and the ordinate represents liver function indexes (U/L). The ALT and AST of children with jaundice in the control group after treatment were (45.68±15.55) U/L and (44.27±15.94) U/L, respectively. The ALT and AST of children with jaundice in the experimental group after treatment were (37.26±10.72) U/L and (36.84±13.14) U/L, respectively. There was a significant difference in ALT between the control group and the experimental group (t=4.888, **P<0.01). There was a significant difference in AST between the control group and the experimental group of children with jaundice after treatment (t=2.934, **P<0.01).

ly, most newborns exhibit physiologic jaundice within one week after birth [8-12]. If the newborn shows low blood sugar, high fever, dehydration, and hypoxia, it can easily evolve into pathological jaundice. Once it progresses to pathological jaundice, and cannot be treated in time, it will result in irreparable and major trauma to the newborn's body and intelligence. Therefore, a more effective treatment method against neonatal jaundice should be addressed by medical scholars.

Conventional treatment methods inject albumin and provide warmth and nutritional supply to children with jaundice, with unsatisfactory outcomes [13-17]. The phototherapy of blue light is currently the mainstay, in which children with jaundice are placed in a phototherapy incubator for blue light irradiation. After irradiation, the bilirubin in the newborn's body will be absorbed and transformed, and then the absorbed bilirubin is excreted from the body, which can reduce the serum bile concentration, and finally improve the symptoms of jaundice. Ultimately, it reduces the time for neonatal jaundice to subside, and allows the newborn to recover as soon as possible [14, 18, 19].

The authors found that the CK of children with jaundice in the experimental group treated with blue phototherapy was lower than that in the control group. CK mainly exists in skeletal muscle, myocardium, and smooth muscle. If CK is elevated, it predisposes to a variety of diseases, such as acute myocardial infarction, cerebrovascular disease, acute brain trauma, alcoholism, generalized convulsions, seizures, progressive muscular dystrophy, viral myocarditis, and polymyositis. Notably, the CK of children with jaundice in the control group after conventional treatment was (201.36±71.93) U/L, and the CK of children in the experimental group with jaundice after blue phototherapy was (176.39±59.3) U/L. This was consistent with the findings of Fei et al., wherein they pointed out that the CK of the experimental group of children with jaundice after blue phototherapy was (178.96±60.33) U/L, which was significantly lower than the (202.35±70.54) U/L of the control group after treatment, indicating that phototherapy is more effective in clinical treatment than conventional treatment.

In summary, the main cause of neonatal jaundice is the increase in serum bile concentration caused by bilirubin metabolism disorder, and blue phototherapy is superior to conventional treatment in terms of alleviating the symptoms of neonatal jaundice.

Disclosure of conflict of interest

None.

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