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The Impact of Kangaroo Mother Care Combined with Massage Therapy on Vital Signs and Family Satisfaction in Extremely Preterm Infants

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ABSTRACT: Objective To investigate the effects of kangaroo mother care combined with massage therapy on heart rate, oxygen saturation, perfusion index (PI), systolic blood pressure in extremely premature infants, and the impact on parents' satisfaction with care**.**

Methods A total of 74 extremely premature infants admitted to the Neonatal Intensive Care Unit (NICU) of Xinxiang Central Hospital from January 2024 to January 2025 were selected as the study subjects and randomly divided into the control group and the intervention group. The control group received routine care, while the intervention group received kangaroo mother care combined with massage therapy. Kangaroo mother care was performed once daily for 2 hours, lasting for 4 weeks, and massage therapy was conducted during kangaroo mother care, lasting 10 minutes for 2 times. The heart rate, oxygen saturation, PI value, and systolic blood pressure of the two groups of premature infants were compared on the 1st, 7th, 14th, 21st, and 28th days of intervention, and the parents' satisfaction with care at discharge was compared between the two groups**.**

Results 1. On the 7th, 14th, 21st, and 28th days of intervention, the PI value and oxygen saturation of the premature infants in the intervention group were significantly higher than those in the control group. 2. At discharge, the parents' satisfaction with care in the intervention group was significantly higher than that in the control group.

Conclusion Kangaroo mother care combined with massage therapy can significantly increase the oxygen saturation in extremely premature infants, improve peripheral circulation perfusion, and enhance parents' satisfaction with care.

KEYWORDS: Extremely premature infants; Kangaroo mother care;Massage therapy ;Vital signs;Nursing satisfaction

I. INTRODUCTION

According to the statistics of the World Health Organization, approximately 15 million babies are born prematurely each year, with an incidence rate ranging from 5% to 18% in 184 countries and regions[1]. In China, in 2021, 1.1723 million premature infants were born, accounting for 7.81% of the world's premature infants, ranking second in the world[2]. After premature birth, the organ systems of premature infants are not yet fully developed and are unable to face the unfamiliar survival environment outside the mother's womb. They are prone to unstable vital signs such as breathing difficulties, decreased blood oxygen saturation, and abnormal heart rates (too fast or too slow)[3]. Currently, the main nursing goal for premature infants in the Neonatal Intensive Care Unit (NICU) is to provide them with a suitable incubation environment, allowing them to grow and develop in an environment similar to that in the mother's body, thereby maintaining stable vital signs and reducing short - and long - term complications. Extremely premature infants need to be hospitalized in the NICU after birth. During the treatment period, parents cannot accompany their children. Excessive worry about the prognosis of the disease and limited communication with medical staff can lead to increased nurse - patient conflicts, resulting in low parental nursing satisfaction[4]. Research has confirmed that Kangaroo Mother Care can be an effective measure to reduce neonatal mortality, improve the success rate of breastfeeding, promote parent - child relationships, and facilitate the formation and development of healthy behaviors in neonates and their families[5-6]. However, current studies on Kangaroo Mother Care have relatively short implementation durations, and there are few monitoring of peripheral circulation perfusion indicators. Therefore, in this study, the implementation duration of Kangaroo Mother Care was set at 2 hours per session for 4 consecutive weeks, and peripheral circulation perfusion indicators were monitored to evaluate its actual impact on the vital signs of premature infants and the nursing satisfaction of their families.

II. SUBJECTS AND METHODS

A. Research Subjects

Seventy - four premature infants with a gestational age of 28 to 31+6 weeks admitted to the NICU of Xinxiang Central Hospital from January 2024 to January 2025 were selected as the research subjects. They were randomly divided into a control group and an intervention group of 37 cases each in the order of admission time. Inclusion criteria for premature infants: ① Gestational age of 28 to 31 + 6 weeks; ② Apgar score of 7-10 at 10 minutes after birth; ③ Tolerance to Kangaroo Mother Care; ④ Informed consent from family members. Inclusion criteria for parents: Agreement to participate in this study, signing of the informed consent form, and good communication skills. Exclusion criteria for premature infants: ① Congenital genetic metabolic diseases; ② Complex congenital heart diseases; ③ Incomplete medical records; ④ Severe congenital malformations. Exclusion criteria for parents: ① Refusal to participate in this study; ② Inability to understand the corresponding content in the questionnaire; ③ Infectious or mental diseases; ④ Failure to complete 4 weeks of Kangaroo Mother Care. This study was approved by the Ethics Committee of our hospital (Approval No.: 2023-803), and the families of the infants provided informed consent.

B. Research Methods

Premature infants in the control group received routine nursing care. Premature infants in the intervention group were given Kangaroo Mother Care once a day for 2 hours each time for 4 weeks.

Routine Nursing Measures: Referring to the "Guidelines for the Management of Premature Infants"[7], routine monitoring, treatment, and nursing care were provided for extremely premature infants, including warmth preservation, respiratory management, circulatory management, nutritional support, infection prevention, maintenance of stable blood glucose, prevention of water - electrolyte imbalance, and prevention of brain injury. The temperature and humidity in the neonatal incubator were adjusted according to the gestational age and day - age of the premature infant. A cardiac monitor was used to routinely monitor the vital signs of premature infants. The weight was measured once a day, the body temperature was measured once, and the 24 - hour intake and output of the infant were recorded.

Implementation Process of Kangaroo Mother Care: The operation method of Kangaroo Mother Care was introduced to the family members, and an operation video was played. The family members first lay on a sofa or reclining chair and adjusted to a comfortable semi - lying position (tilted at approximately 60°). They opened their upper garments, placed the premature infant between the two nipples, in a "frog - like" position, with the head tilted to one side to maintain unobstructed breathing. The parent supported the back of the premature infant's neck with one hand and the buttocks with the other hand or arm. A thin blanket was used to cover the back of the premature infant for warmth, ensuring that the face, chest, abdomen, arms, and legs of the premature infant were in close contact with the skin of the parent's chest and abdomen. During the implementation, the vital signs of the premature infant were observed to prevent accidents.

C. Research Tools

1)Measurement Methods for Heart Rate, Blood Oxygen Saturation, and PI Value: The probe of the Masimo Radical-7 (USA) pulse oximeter was connected to the right palm of the infant. After the waveform stabilized, data was recorded every 10 seconds for a total of 3 times, and the average of the 3 measurements was taken as the final heart rate, blood oxygen saturation, and PI value of the premature infant.

2)Measurement Method for Systolic Blood Pressure: The Mindray BeneVision N12Neo cardiac monitor was used for measurement. An appropriately sized cuff (the ratio of cuff width to upper arm circumference was 0.45-0.70) was selected and wrapped around the upper part of the infant's upper arm at the level of the right atrium. The cuff was adjusted to an appropriate tightness, and the monitor button was pressed to start the measurement.

3)Family Satisfaction Questionnaire: The Nursing Work Satisfaction Questionnaire for Inpatients of Xinxiang Central Hospital was used to evaluate family satisfaction. The questionnaire consisted of 20 items. A 5 - level scoring method was used to score each item, with "very dissatisfied", "dissatisfied", "average", "satisfied", and "very satisfied" assigned values of "1 point", "2 points", "3 points", "4 points", and "5 points" respectively. The total satisfaction score was obtained by adding up the scores of each item.

D. Observation Indicators

Observation Indicators for Premature Infants: The 1st, 7th, 14th, 21st, and 28th days after the implementation of the intervention were set as fixed recording times. During the implementation of Kangaroo Mother Care, the heart rate, blood oxygen saturation, PI value, and systolic blood pressure of the patients were observed and recorded.

Observation Indicators for Premature Infants' Parents: The nursing satisfaction of the family members was surveyed at the time of discharge.

E. Data Analysis

SPSS 27.0 was used to analyze the data. Count data were expressed as frequencies, and the chi-square test was used for inter-group comparisons. Measurement data that followed a normal distribution were expressed as mean ± standard deviation ($\bar{x}\pm s$). Independent-sample t-tests were used for pairwise comparisons between groups, and repeated-measures analysis of variance was used for comparing repeated-measurement data between the two groups. A two-sided $P < 0.05$ indicated a statistically significant difference.

III. RESULTS

A. Comparison of General Data of Premature Infants in the Two Groups

There were no statistically significant differences ($P > 0.05$) in the gestational age, birth weight, gender, heart rate, blood oxygen saturation, PI value, and systolic blood pressure of the premature infants in the two groups at the start of the intervention. The general data between the groups were comparable, as shown in Table 1.

Table 1 Comparison of General Information at Admission Between the Two Groups

Group	Control Group (N = 37)	Intervention Group (N = 37)	t/χ^2	P
Gestational Age at Birth (weeks)	29.56 ± 0.83	29.59 ± 0.71	-0.114	0.910b
Birth Weight (kg)	1480 ± 170	1420 ± 190	-0.820	0.415b
Gender (Male/Female)	19/18	20/17	0.018	0.893a
Heart Rate (beats/min)	151.81 ± 5.83	152.43 ± 6.45	-0.399	0.692b
Blood Oxygen Saturation (%)	90.71 ± 1.93	91.63 ± 2.50	-1.617	0.111b
PI	1.51 ± 0.18	1.46 ± 0.17	0.951	0.345b
Systolic Blood Pressure (mmHg)	52.29 ± 2.27	53.30 ± 2.98	-1.491	0.141b

Note: a: Chi - square test; b: Independent - sample t – test

B. Comparison of Heart Rate, Blood Oxygen Saturation, PI Value, and Systolic Blood Pressure of Premature Infants in the Two Groups Before and After the Intervention

After comparing the heart rate, blood oxygen saturation, PI value, and systolic blood pressure of the premature infants in the two groups after the intervention, the results showed that the blood oxygen saturation and PI value of the premature infants in the intervention group were significantly higher than those in the control group on the 7th, 14th, 21st, and 28th days after the intervention, and the differences were statistically significant ($P < 0.05$), as shown in Table 2.

Table 2 Comparison of heart rate, blood oxygen saturation, PI value, and systolic blood pressure between two groups of premature infants after intervention

Time	Control Group (N = 37)	Intervention Group (N = 37)	t	P
Heart Rate (beats/min)				
Day 1	156.35 ± 8.34	156.67 ± 6.55	-0.162	0.872
Day 7	153.35 ± 5.62	151.77 ± 6.95	0.983	0.330
Day 14	146.48 ± 4.00	145.13 ± 4.16	1.293	0.201
Day 21	142.90 ± 3.42	141.17 ± 3.59	1.934	0.058
Day 28	136.97 ± 2.64	135.77 ± 2.75	1.741	0.087

Time	Control Group (N = 37)	Intervention Group (N = 37)	t	P
Blood Oxygen Saturation (%)				
Day 1	91.58 ± 2.45	91.27 ± 1.92	0.555	0.581
Day 7	91.58 ± 1.91	94.10 ± 1.67	-5.478	<0.001
Day 14	91.65 ± 1.52	95.80 ± 1.45	-10.933	<0.001
Day 21	92.29 ± 1.51	94.13 ± 1.87	-4.241	<0.001
Day 28	92.61 ± 1.52	95.00 ± 1.82	-5.568	<0.001
PI				
Day 1	1.42 ± 0.17	1.48 ± 0.20	-1.287	0.203
Day 7	1.78 ± 0.14	2.28 ± 0.18	-11.903	<0.001
Day 14	1.75 ± 0.13	2.25 ± 0.17	-12.680	<0.001
Day 21	2.07 ± 0.18	2.65 ± 0.19	-12.338	<0.001
Day 28	2.14 ± 0.17	2.78 ± 0.27	-11.208	<0.001
Systolic Blood Pressure (mmHg)				
Day 1	60.48 ± 2.12	60.73 ± 1.91	-0.481	0.632
Day 7	62.29 ± 3.24	63.63 ± 1.99	-1.944	0.057
Day 14	64.84 ± 4.07	66.10 ± 4.46	-1.155	0.253
Day 21	66.68 ± 3.59	67.30 ± 3.74	-0.663	0.510
Day 28	68.26 ± 2.83	69.47 ± 2.74	-1.695	0.095

C. Repeated measures ANOVA results of vital signs in two groups of premature infants

The repeated measures ANOVA results of heart rate, blood oxygen saturation, PI value, and systolic blood pressure at five time points of intervention on day 1, day 7, day 14, day 21, and day 28 showed that there were statistically significant differences ($P<0.05$) in blood oxygen saturation and PI value between the two groups of extremely premature infants in terms of grouping effect, time effect, and interaction effect between time and grouping, as shown in Table 3.

Table 3 Results of repeated measures ANOVA of vital signs in two groups of premature infants

Project	F	Degree of freedom	P
heart rate			
Intervention main effect	3.433	1	0.069
Time main effect	172.671	4	＜0.001
Intervention * time interaction effect	0.086	4	0.986
oxygen saturation			
Intervention main effect	19.362	1	＜0.001
Time main effect	14.243	4	＜0.001
Intervention * time interaction effect	3.990	4	0.006

PI value			
Intervention main effect	53.412	1	＜0.001
Time main effect	164.444	4	＜0.001
Intervention * time interaction effect	6.831	4	＜0.001
systolic blood pressure			
Intervention main effect	2.322	1	0.133
Time main effect	118.280	4	＜0.001
Intervention * time interaction effect	0.636	4	0.615

D. Comparison of Nursing Satisfaction of Premature Infants' Parents in the Two Groups Before and After the Intervention

By comparing the nursing satisfaction of premature infants' parents at the time of discharge in the two groups, it was found that the nursing satisfaction of the intervention group was significantly higher than that of the control group, and the difference was statistically significant ($P < 0.05$), as shown in Table 4.

Table 4 Comparison of nursing satisfaction between parents of premature infants in two groups upon discharge

Item	**Control Group (N = 37)**	**Intervention Group (N = 37)**	**t**	**P**
Nursing Satisfaction	83.81 ± 3.17	90.03 ± 3.15	-7.703	<0.001

IV. DISCUSSION

Frequent exposure to stressful events such as noise and pain in the NICU can cause certain harm to the respiratory and circulatory systems of premature infants, leading to some clinical manifestations of excessive sympathetic nerve activation, such as apnea, elevated blood pressure, and abnormal heart rates (too fast or too slow)[8]. Optimizing nursing measures to reduce the adverse stimulation of stressful events on premature infants has a positive impact on stabilizing the physiological state of premature infants. The impact of Kangaroo Mother Care on the respiratory and circulatory functions of premature infants remains controversial[9-10]. Parents play an important role in the nursing process of premature infants, and their nursing satisfaction directly affects the quality of home care for premature infants after discharge. Therefore, this study mainly explored the impact of Kangaroo Mother Care on the heart rate, blood oxygen saturation, PI value, and systolic blood pressure of extremely premature infants and the nursing satisfaction of their parents.

This study found that the heart rate of extremely premature infants remained stable after Kangaroo Mother Care intervention, confirming the safety of applying Kangaroo Mother Care to extremely premature infants. The blood oxygen saturation and PI value of extremely premature infants on the 7th, 14th, 21st, and 28th days after Kangaroo Mother Care intervention were significantly higher than those in the control group. This indicates that the respiratory and circulatory system functions of extremely premature infants were improved after the implementation of Kangaroo Mother Care, enabling them to more effectively absorb and utilize oxygen. The possible mechanism is that the skin - to - skin contact between the mother and the infant during Kangaroo Mother Care can provide a warm and stable environment, reducing the energy consumption and stress response of premature infants. At the same time, it can promote the development of the autonomous breathing and cardiopulmonary function of premature infants, thereby increasing blood oxygen saturation and improving circulatory perfusion. The nursing satisfaction of parents participating in Kangaroo Mother Care increased significantly at the time of discharge. This result suggests that Kangaroo Mother Care has a positive impact on the psychological and emotional states of parents. During the nursing process, parents learned correct nursing methods and skills through close cooperation with medical staff, enhancing their understanding and care - giving ability for premature infants[11].

Schlez et al.[12]found that there was no significant improvement in the physiological indicators such as heart rate, respiratory rate, and blood oxygen saturation of premature infants after Kangaroo Mother Care intervention. It may be related to the fact that the skin - to - skin contact and upright position of Kangaroo Mother Care can effectively stimulate the respiratory center of premature infants, promoting lung development and gas exchange[13]. The study by Meder et al.[14] showed that compared with infants receiving routine hospital care, infants receiving Kangaroo Mother Care had better cardiopulmonary stability. The PI value is significantly related to the peripheral circulation perfusion of children. The increase in the PI value after Kangaroo Mother Care proves that it has a beneficial effect on the peripheral microcirculation perfusion of premature infants[15]. A study in 2021 found that Kangaroo Mother Care could significantly reduce the anxiety level of mothers and ease doctor - patient

communicationconflicts[16]. Sinha et al.'s[17] research indicated that Kangaroo Mother Care significantly reduced the risk of maternal depression by increasing mutual understanding and support between doctors and patients. Although this study has achieved positive results, the sample size is relatively small. In the future, the sample size can be expanded, and long - term follow - up can be carried out to further verify the effectiveness of Kangaroo Mother Care.

In conclusion, as an effective nursing intervention measure, Kangaroo Mother Care has a significant effect on improving the vital signs of extremely premature infants and enhancing the nursing satisfaction of parents. It is worthy of promotion and application in clinical practice.

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