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Research Article

Effect of Early Nursing Intervention under Amplitude-Integrated Electroencephalography and Magnetic Resonance Images on Brain Injury in Premature Infants

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To investigate the effects of early nursing intervention on brain injury among premature infants, 100 premature infants diagnosed with brain injury were included in the research and randomly divided into the control group (50 cases) and the experimental group (50 cases). The patients in the two groups were performed with the same conventional comprehensive treatment. The patients in the control group received conventional nursing while those in the experimental group underwent early nursing intervention. During follow-up, neurodevelopment, motor behavior, the incidence rate of brain injury, and nursing satisfaction of the infants in the two groups were compared. It was demonstrated that the five neurodevelopment scores of the experimental group were all higher than those of the control group. The differences showed statistical significance ($P < 0.05$). The total effective rate of motor development of the experimental group reached 94%, while that of the control group amounted to 80%. Obviously, the total effective rate of motor development of the experimental group was higher than that of the control group. The difference was statistically significant ($P < 0.05$). The nursing satisfaction of the experimental group reached 98%, which was apparently higher than that of the control group (74%). The difference suggested statistical significance ($P < 0.05$). The rates of brain injury at 1 and 2 years after the birth of the experimental group were 6% and 2%, respectively. The rates of brain injury at 1 and 2 years after the birth of the control group amounted to 18% and 14%, respectively. The rates of brain injury at 1 and 2 years after the birth of the experimental group were lower than those of the control group. The difference revealed statistical significance ($P < 0.05$). Hence, the early nursing intervention of premature infants with brain injury could promote brain development, improve neurological function, reduce the incidence of brain injury, and achieve an ideal nursing effect.

1. Introduction

Preterm infants refer to newborns whose gestational age is less than 37 weeks. In recent years, with the progress of medical technology, the birth rate and survival rate of preterm infants around the world have increased remarkably [1]. However, due to the immature development of some tissues and organs of premature infants, some complications are easily caused. Investigation showed that among all complications of premature infants, the incidence rate of brain injury in preterm infants (BIPI) can reach approximately 15% [2]. Nearly half of the premature infants born in China every year will suffer from brain injury, which usually includes intracranial hemorrhage, white matter injury, cerebral infarction, and intracranial infection. A brain injury will lead to neurological damage in children, with varying degrees of impairment in motor function, intelligence, emotional ability, vision, and other aspects, which will remarkably reduce the quality of life of children.

Premature infants are prone to brain injury due to premature separation from the mother, insufficient gestational age, immature brain development, and low sensitivity to a hypoxic environment. Brain injury is mainly caused by infection. Premature rupture of membranes and chorioamnionitis can lead to infection in premature infants. In addition, fetal asphyxia, shock, and abnormalities of the mother's placenta, and umbilical cord also affect the neurons of children and cause brain injury. BIPI comes in two forms, namely, hemorrhagic and nonhemorrhagic brain damage. The former can lead to neurodevelopmental disorders in severe cases, and the latter can lead to visual and hearing impairment in severe cases. Immediate intervention can reduce the risk of complications in premature infants. At present, the prevention methods of premature brain injury mainly include prenatal use of $MgSO_4$ and postpartum use of erythropoietin [3–8]. In addition to providing symptomatic treatment, it is necessary to identify as early as possible children who may encounter such conditions during late development. With the development of science and medical research, imaging examination has been widely used and accepted by the public. It has become an indispensable method to diagnose premature brain injury. Amplitude-integrated electroencephalography (aEEG) and magnetic resonance imaging (MRI) can be used for the real-time monitoring of premature infants and as predictive indicators for the diagnosis of brain injury in premature infants. AEEG can perform bedside monitoring for premature infants, display amplitude waves of EEG signals, and understand their neurophysiological activities. This method is intuitive, simple, noninvasive, and efficient [9–12]. MRI can detect small brain abnormalities and intracranial bleeding and accurately detect the scope and size of the lesion site. Its sensitivity and specificity are extremely high. MRI can predict the neurodevelopment of preschool-age infants when the gestational age is corrected to full term. The combination of the two imaging examination methods can provide a reliable basis for doctors to diagnose premature brain injury, avoid misdiagnosis and missed diagnosis, and improve the diagnosis rate [13, 14]. According to the results of aEEG and MRI, doctors can formulate appropriate treatment plans to prevent more sequelae, improve the condition of premature infants with brain injury, improve the survival rate of premature infants, and reduce the burden on families and society.

The adoption of correct and effective early nursing measures for premature infants with brain injury can promote the growth and development of children, reduce complications and the treatment time, alleviate the condition of children, and improve the cure rate, which is of great significance for the treatment of premature infants with brain injury. One hundred premature infants diagnosed with brain injury by aEEG and MRI imaging examinations were recruited. According to the random principle, they were divided into the control group and the experimental group. The two groups of patients received the same conventional comprehensive treatment. Those in the control group received conventional nursing, while those in the experimental group were given visual, motor, intelligence, and other aspects of early nursing intervention. The two groups of children were compared regarding neurological development, motor behavior, brain injury rate 1 year and 2 years later, and nursing satisfaction score to explore the clinical efficacy of the early nursing intervention on premature brain injury.

2. Methods

2.1. Basic Data. In this study, 100 premature infants delivered in a hospital with gestational age less than 37 months and confirmed by aEEG and MRI imaging examination were included. They were randomly divided into a control group and an experimental group. In the control group, there were 50 premature infants, including 28 males and 22 females, with a gestational age of 29–37 weeks. The average gestational age was 33.5 ± 3.2 weeks, body weight was 920–2,600 g, and average body weight was $1,480 \pm 350$ g. In the experimental group, there were 26 males and 24 females with gestational ages of 28–36 weeks. The mean gestational age was 31.7 ± 3.6 weeks, the body weight was 890–2,700 g, and the mean body weight was $1,390 \pm 320$ g. There was no great difference between the control group and the experimental group in sex, body weight, gestational age, or other general data, $P > 0.05$, which was comparable. All guardians signed informed consent forms, and the study was approved by the ethics committee of the hospital.

Inclusion criteria were as follows: (i) premature infants with a gestational age over 28 weeks but less than 37 weeks; (ii) no history of suffocation; (iii) the mother had no serious complications. Exclusion criteria were as follows: (i) congenital malformation; (ii) severe hypoxic-ischemic encephalopathy.

2.2. AEEG Monitoring and MRI Examination. Preterm infants with suspected brain injury were admitted for aEEG monitoring within 3 days of birth and head MRI examination at 40 weeks.

AEEG monitoring was as follows. The brain function monitor was used to perform operations according to relevant standards. Each monitoring time was over 2 h, and continuous monitoring was performed for 3 days. To avoid interference, sedatives, anesthetics, and antiepileptic drugs should not be used in the monitoring process, and the data whose impedance was higher than $10\,\Omega$ in the aEEG monitoring data obtained should be discarded. The data obtained were obtained by two qualified physicians.

A head MRI examination was performed as follows: the child's head was fixed with a sponge pad using a head orthogonal coil. A 1.5 T MRI scanner was used, and the examinations included T1-weighted, T2-weighted, and diffusion-weighted imaging (T1W1, T2W1, and DW1). Normal neonatal brain MRI signals were as follows: T1W1: high cortex, low white matter, high myelination, low cerebrospinal fluid, low skull, and high fat; T2W1: low cortex, high white matter, low myelination, high cerebrospinal fluid, low skull, and high fat. MRI signals of common lesions were as follows: T1W1: high bleeding, low infarction, low edema, and low softening; T2W1: low bleeding, high infarction, high edema, and high softening.

2.3. Nursing Intervention. Both groups underwent aEEG and MRI imaging examinations and received the same conventional comprehensive treatment, including drugs and routine health care. The control group received intervention according to routine nursing requirements for premature infants, and the children's basic state (including spirit, nutrition, sleep, and diet) was observed and recorded. The basic physical signs of the children and appropriate temperature and humidity were maintained, and relevant health guidance was provided. The experimental group of children received the early nursing intervention.

According to gestational age and degree of brain injury, early nursing programs were made for the children in the experimental group. First, the medical staff needed to create a comfortable environment for the children, and the "bird's nest" posture was established to ensure that children had the appropriate and correct posture. Second, the medical staff should gently stimulate the children to make them feel similar to the environment in the womb, maintain their breathing rate, and avoid overstimulation. Third, the medical staff touched the children and adjusted the indoor temperature and humidity to maintain the temperature at 22–24°C and humidity between 50% and 60%. The nursing staff first washed their hands, then rubbed their hands with massage oil and heat, and then touched the children. Fifteen repeated strokes were performed on each part, including the head, chest and abdomen, back, hands, feet, and limbs. Fourth, the medical staff explained the content and purpose of early nursing intervention to the guardians, popularized training methods and nursing knowledge, and urged parents to participate in the early nursing of children. The medical staff guided parents to carry out early training and exercise children's motor ability and visual perception ability. For example, parents can play no more than 50 dB of relaxed and cheerful music every day for music intervention. Regular baby exercises were performed, such as the use of bell training motor ability. Parents can communicate with children to promote brain development. The neurobehavioral and motor abilities of the two groups were followed up. During training, children should follow the law of movement and development, avoiding excessive stimulation.

2.4. Indicators. The children were followed up, and the neurological development and motor development of the children were measured. AEEG and MRI were used to examine the brain injury rate of the children and collect the nursing satisfaction score. (I). Neonatal Behavioral Neurological Assessment (NBNA) was used to evaluate the neural development of five indexes, namely, primitive reflex ability, behavioral ability, active muscle tension, passive muscle tension, and general reaction ability. The higher the score, the better the development. (II). Sixty-one motor measurement indexes were evaluated by using the infant development test of the Child Development Center of China (CDCC) to evaluate the children's motor coordination and skill and behavioral ability. The scores were graded into five criteria, and the calculation efficiency was excellent (≥130 points), good (120–129 points), normal (110–119 points), low (90–109 points), and defective (< 80 points). (III). The children in the two groups were examined by aEEG and MRI at one year and two years after birth to analyze the rate of brain injury. (IV). A questionnaire survey was conducted, and the guardian scored nursing satisfaction in the form of anonymity. The full score was 100, and the evaluation was set as three levels as follows: very satisfied (≥ 90 points), satisfied (70–89 points), and dissatisfied (< 70 points).

$$\begin{aligned}\text{Effective rate of motor development} &= \frac{(\text{excellent} + \text{good} + \text{normal})\text{cases}}{\text{total cases}} \times 100\%,\\ \text{Brain injury rate} &= \frac{\text{number of brain injury}}{\text{total number of each group}}.\end{aligned} \tag{1}$$

2.5. Statistical Methods. All data were statistically analyzed by SPSS 26.0. Count data were tested by χ^2 test, and measurement data were tested by t-test and were expressed as the mean ± standard deviation ($\overline{x} \pm s$). $P < 0.05$ indicated a considerable difference; otherwise, $P > 0.05$ indicated no statistical significance. The measurement data included the NBNA score and CDCC score.

3. Results

3.1. AEEG and MRI Imaging Results. Figures 1 and 2 below show the aEEG and MRI images of children with different brain injuries, respectively. The aEEG images showed continuous high-amplitude waves, and the patients examined by MRI had epidural hemorrhage (EDH).

3.2. Comparison of Neurodevelopmental Status. The five indicators of behavioral neuropathy in the experimental group, namely, original reflex ability, behavioral ability, active muscle tension, passive muscle tension, and general reaction ability scores, were higher than those in the control group. The total score was higher than that in the control group, and the development was stronger than that in the control group. The differences were considerable ($P < 0.05$) (Figure 3).

3.3. Comparison of Motor Behavior. 61 physical activity measurements were evaluated by CDCC in both groups. In the experimental group, 17 cases were excellent (34%), 19 cases were good (38%), 11 cases were normal (22%), 2 cases were low (4%), and 1 case was defective (<2%). In the control

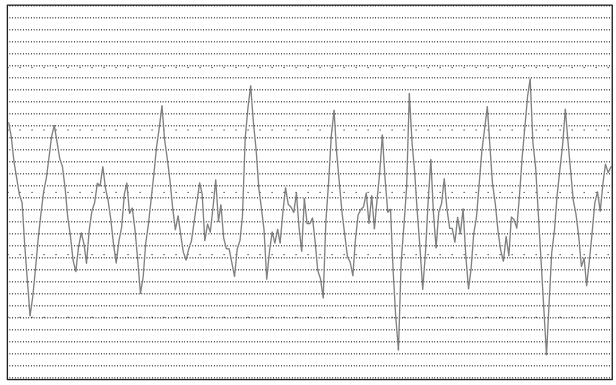

Figure 1: AEEG imaging of premature infants with brain injury.

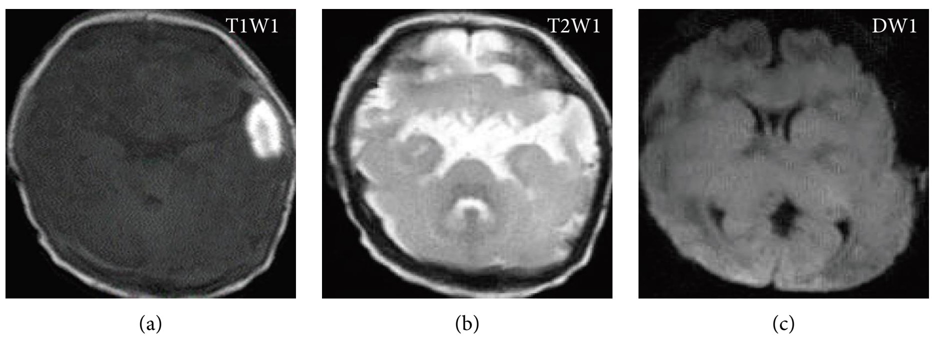

Figure 2: MRI imaging of premature infants with brain injury: (a) T1-weighted image; (b) T2-weighted image; (c) diffusion-weighted imaging.

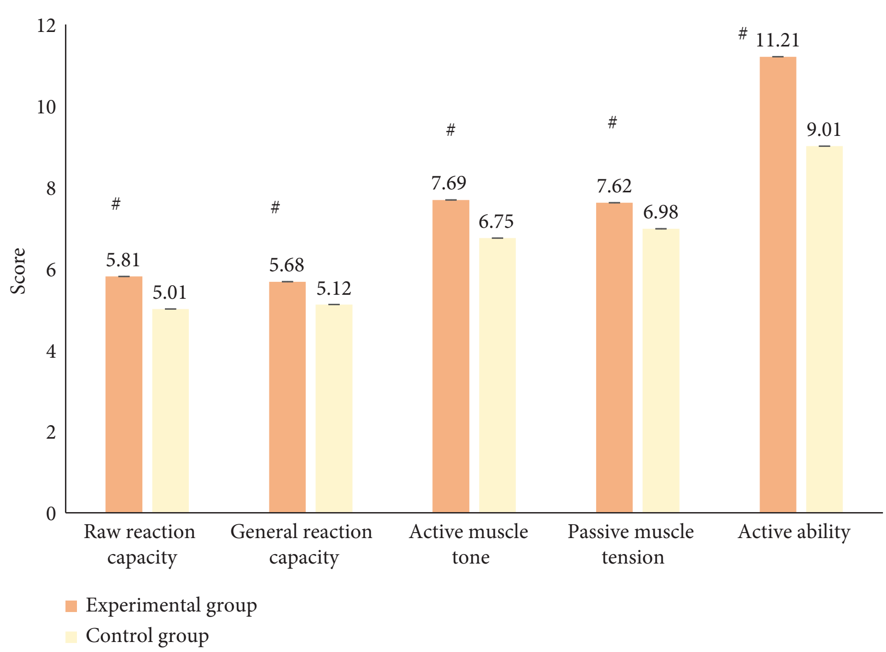

Figure 3: Comparison of neurodevelopmental status between the two groups ($n = 50$). #Compared with the control group, $P < 0.05$.

group, 11 cases were excellent (22%), 15 cases were good (30%), 14 cases were normal (28%), 6 cases were low (12%), and 4 cases were defective (<8%). The motor development rate of the experimental group was higher than that of the control group, and the difference between the two groups was considerable ($P < 0.05$) (Figure 4).

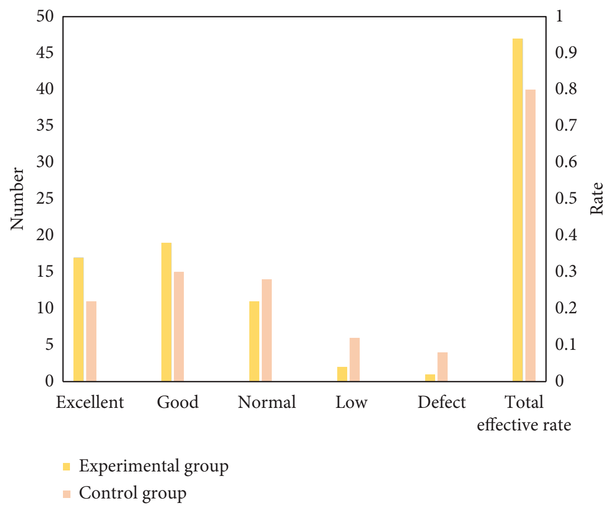

FIGURE 4: Comparison of motor development between two groups. *compared with the control group, $P < 0.05$.

3.4. Comparison of Brain Injury Rates at One Year and Two Years after Birth. In the experimental group, the rates of brain injury at 1 year and 2 years after birth were 6% (3 cases) and 2% (1 case), respectively. In the control group, the rates of brain injury at 1 year and 2 years after birth were 18% (9 cases) and 14% (7 cases), respectively. The difference in the interbrain injury rate between the two groups was considerable ($P < 0.05$) (Figure 5).

3.5. Comparison of Nursing Satisfaction. In the experimental group, 52% (26) were very satisfied, 46% (23) were satisfied, 2% (1) were dissatisfied, and 98% (49) were satisfied. In the control group, 24% (12) were very satisfied, 50% (25) were satisfied, 26% (13) were dissatisfied, and 74% (37) were satisfied. The difference in total nursing satisfaction between the two groups was considerable ($P < 0.05$) (Figure 6).

4. Discussion

Premature infants are prone to brain damage due to premature separation from the mother, insufficient gestational age, immature brain development, and low sensitivity to anoxic environments. As a result, different degrees of movement, intelligence, emotion, vision, and other disorders occur in children, which results in many sequelae and remarkably reduces their quality of life [15–17]. Research analysis found that the main causes of premature brain injury are as follows: (i) premature cells and organs are not mature and vulnerable to interference of various factors, and white matter is easily damaged, resulting in ventricular hemorrhage; (ii) premature infants suffer from insufficient blood supply to the brain and nervous system due to poor regulatory function; (iii) premature infants have underdeveloped brains and poor endocrine function and are prone to various problems caused by external factors [18]. The application of aEEG and MRI can identify children who may experience brain injury in later development as early as possible, remarkably reduce sequelae, improve the survival rate of premature infants, and relieve the burden on families and society. Correct and effective early nursing measures for premature infants with brain injury can promote the growth and development of infants, reduce complications and treatment time, relieve the illness of infants, and improve the cure rate, which is of great significance for the treatment of premature infants with brain injury [19]. To explore the clinical efficacy of the early nursing intervention on brain injury in premature infants, 100 cases of premature infants diagnosed with brain injury by aEEG and MRI imaging examination in the hospital were included. According to the principle of randomness, they were divided into a control group with 50 cases and an experimental group with 50 cases. Both groups received the same conventional combination therapy. The control group was given routine nursing, while the experimental group was given visual, motor, intelligence, and other aspects of early nursing intervention. Neurological development, motor behavior, brain injury rate, and nursing satisfaction score were compared between the two groups after one and two years. The differences in gender, gestational age, and weight between the two groups showed no statistical significance but comparability ($P > 0.05$).

According to the research results, the scores for five indicators of behavioral neuropathy, namely, original reflex ability, behavioral ability, active muscle tension, passive muscle tension, and general reaction ability, the total effective rate of motor development assessed by CDCC, and nursing satisfaction in the experimental group were all higher than those in the control group ($P < 0.05$). The early nursing intervention involved posture, early training, and touch. A comfortable and safe environment should be created for premature infants to help them adapt to in vitro environment as soon as possible. The early nursing intervention combined with conventional nursing for premature infants with brain injury could improve infants' behavioral and communicative abilities, promote brain development, improve neurological function, and accelerate recovery. In general, it is beneficial to infants' physical and mental health as well as intelligence. The rates of brain injury in infants in the experimental group at 1 and 2 years after birth were both higher than those in the control group ($P < 0.05$), indicating that early nursing intervention could remarkably reduce brain injury. After premature infants undergoing early nursing intervention are discharged from the hospital, their parents should carry out conventional nursing to keep comfortable temperature and humidity and ensure normal basic vital signs. Breastfeeding was the preferred feeding method for premature infants because it could promote neurodevelopment [20]. The family intervention was emphasized during the early nursing intervention. Parents assisted patients to complete all activities, helped improve the compensation function of their brains, and promoted their intelligence, physical, and mental development. The research results suggested that early nursing intervention achieved ideal nursing effects. It was the preferred option for brain injury among premature infants and a purposeful and planned intervention scheme.

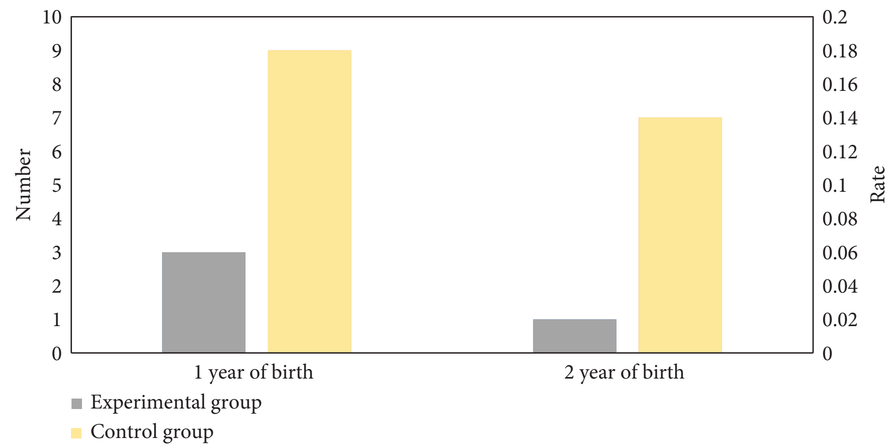

Figure 5: Comparison of brain injury rates between 1 year and 2 years after birth between two groups. & compared with the control group, $P < 0.05$.

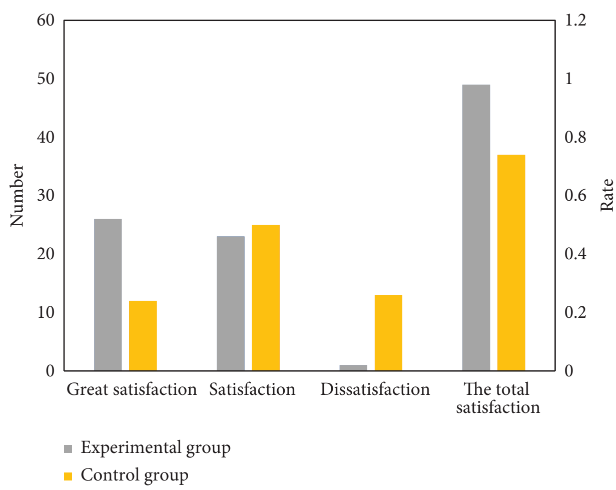

Figure 6: Comparison of nursing satisfaction between two groups. $ compared with the control group, $P < 0.05$.

5. Conclusion

The results indicated that the scores for five indicators of behavioral neuropathy, the total effective rate of motor development, and the total satisfaction of the experimental group were all higher than those of the control group. In contrast, the incidence rate of brain injury at 1 and 2 years after birth was lower than that of the control group. However, there were still some disadvantages to the research. Firstly, the communication with patients' parents was insufficient during early nursing intervention for the experimental group, which might make it impossible to realize the optimal nursing and training for patients. Secondly, the included cases were insufficient, which might lead to data errors. To sum up, early nursing intervention for premature infants with brain injury could improve neurological function and reduce the incidence rate of brain injury. The research provided data support for the investigation into the clinical effects of early nursing intervention on brain injury among premature infants.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

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