

## Original Article

# Clinical effect of comprehensive nursing intervention for children with traumatic brain injury

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**Abstract:** Objective: To investigate the effects of comprehensive nursing intervention on neurological recovery, motor function, intelligence, and daily living ability in children with traumatic brain injury. Methods: We recruited 100 children with traumatic brain injury and retrospectively analyzed the clinical data. According to the actual practice of nursing, the cases were divided into two groups, the comprehensive nursing group (n=50) given comprehensive nursing care and the conventional nursing group (n=50) given routine nursing care. The incidence of cerebral palsy, and scores of the developmental quotient (DQ), psychomotor development index (PDI), mental developmental index (MDI), National Institutes of Health Stroke Scale (NIHSS) and Activities of Daily Living (ADL) were compared between the two groups. Results: Compared with the conventional nursing group, the incidence rate of cerebral palsy was significantly reduced in the comprehensive nursing group ( $P<0.05$ ); the scores of the DQ, PDI, MDI and ADL were significantly improved (all  $P<0.001$ ); and the NIHSS score was significantly reduced ( $P<0.001$ ). Conclusion: Comprehensive nursing intervention can promote intellectual and motor development, and improve neurological function and daily living ability, with an obvious reduction in the incidence of cerebral palsy. It is worth being promoted in clinical practice.

**Keywords:** Comprehensive nursing, traumatic brain injury, clinical efficacy

## Introduction

Pediatric traumatic brain injury (TBI) is a common clinical acute critical illness. Generally, it refers to damage to the brain in infants and young children caused by different physical and chemical factors, leading to intellectual, motor, cognitive, and neuropsychiatric disabilities [1, 2]. According to epidemiological surveys, its incidence has shown an upward trend in recent years, with approximately 2.5 cases per 1000 children [3, 4]. TBI seriously affects children's physical and intellectual development, and secondary cerebral palsy (CP) results in varying degrees of loss of daily living ability. In addition, TBI can cause pain in children and impose a heavy burden on their families and society if not managed promptly and effectively [5]. As a result, it is urgent to improve the intelligence, motor ability, and daily living ability of children with TBI so as to gradually cultivate their life self-care ability.

At present, under the guidance of the increasingly normative framework for drug quality, it is of great significance to implement effective nursing interventions for children with TBI [6]. Studies have unveiled that early nursing intervention improves symptoms to some extent in children with TBI by promoting remodeling, reversal, and compensation in the brain during critical periods of development [7, 8]. In addition, it was reported that early rehabilitation nursing was beneficial for intelligence and motor development in children with TBI with strong recovery and plasticity of brain functions [9, 10]. However, the effects of conventional nursing intervention are not obvious though clinical symptoms were alleviated to some extent. Besides, conventional nursing only provides routine nursing guidance, health education, and passive counseling services. It attaches less importance to post-discharge care guidance, which results in poor efficacy [11]. Compared with the conventional nursing

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model, comprehensive nursing is an all-around nursing model with high quality that makes moderate adjustments in time and scope to ensure quality services provided for patients through scientific and efficient nursing projects [12].

To date, there have been no relevant reports on the clinical effects of comprehensive nursing intervention for children with TBI. In this study, we observed the effects of comprehensive nursing intervention on neurological recovery, motor function, intelligence and daily living ability of children with TBI, hoping to provide a scientific basis for clinical nursing measures.

## Materials and methods

### Research subjects

A total of 100 children with severe TBI admitted to our hospital from June 2016 to June 2019 were selected and the clinical data were retrospectively analyzed.

The included patients were diagnosed with pediatric severe TBI through imaging examinations such as CT, MRI, and diagnostic criteria, as defined by the US Centers for Disease Control and Prevention in 2018 [13]. All the patients had high risks of TBI, or developmental neurological abnormalities (e.g., motor development delay, abnormal reflexes, abnormal posture or abnormal muscle tone), mental retardation, motor dysfunction, and abnormal behavior, etc. All patients were aged from 2 to 7 with complete clinical data and written informed consent obtained from the well-cooperated family.

Patients with open traumas or compound injuries, metabolic disorders, chromosomal diseases, acute or chronic infectious diseases, severe hearing disorders, congenital heart diseases, and other organic diseases were excluded.

Patient data that met inclusion and exclusion criteria were summarized. According to the actual practice of nursing, the patients were then divided into the conventional nursing group given routine nursing intervention and the comprehensive nursing group given comprehensive nursing intervention on the basis of conventional nursing, with 50 cases in each group. Ethics approval for the study was given

by the Ethics Committee of The Children's Hospital. Written informed consent was obtained from the family of the patients who agreed to be enrolled in this study.

### Nursing methods

Routine treatment was performed to decrease intracranial pressure, control seizures, and maintain a stable internal environment. The conventional nursing group received conventional nursing, i.e., monitoring vital signs, performing laboratory and imaging examinations, drug therapy in accordance with medical order, general health education for patients and their family, and conventional nursing guidance (e.g., medication guidance). On the basis of conventional nursing, the comprehensive nursing group was given comprehensive nursing intervention including health guidance, complication nursing, psychological nursing, diet nursing, and rehabilitation nursing after admission [14-16].

In terms of health guidance, the relevant knowledge of TBI, treatment protocols, and successful cases were introduced to the families of the patients to relieve their fears and doubts. The causes of TBI, nursing points, and prevention and treatment methods were also taught to help them master these basic contents. Their questions were actively and accurately answered to establish a good nurse-patient relationship, and improve the treatment compliance of the patients and their families.

In terms of complication nursing, examinations were performed, and abnormal indicators of the patients were real-time monitored for treatment. If they have seizures or seizure symptoms during treatment, nursing staff should promptly report them to the physician, give antiepileptic drugs to stabilize the condition, and inform their families about simple nursing methods. At the same time, nursing staff should actively turn patients over in bed and give them massages to reduce and prevent the occurrence of complications such as hypostatic pneumonia and pressure ulcers.

In terms of psychological nursing, psychological nursing projects were made to give the patients timely guidance and comfort according to the change of their psychological activities. Nursing staff should try to relieve the

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patients' psychological discomfort to help them maintain a positive attitude to the disease, actively cooperate with the treatment and care, and increase their confidence in recovery. If patients have fear and anxiety, nursing staff should divert their attention by playing games, watching videos, or telling jokes to help them relieve the negative emotions. Besides, proactive communications with the families of the patients were established to alleviate their negative emotions, and respect and care were given by nurses to establish their confidence in overcoming the disease.

In terms of diet nursing, nursing staff assisted the families of the patients to formulate nutrition recipes that provided digestible diet rich in high-quality protein, high calorie, and high-quality vitamins to enhance the resistance and immunity of the patients and avoided overheating and spicy food. With the guidance of nurses, the families also adjusted the feeding methods, appetites and eating speeds of the patients, and focused on dietary environments to ensure the patients' nutritional needs.

In terms of rehabilitation nursing, nursing staff guided the families of the patients to implement basic and long-term rehabilitation training that included limb movement training, infant touch training, and training with audio-visual stimulation. Motor function training included training of fine motor, turning over in bed, crawling, sitting, walking, toileting, and eating. In addition, nurses gave intelligence training for the patients and made communications with them through languages, facial expressions, and physical reactions, which imparted perceptual knowledge, improved their cognition, and thus enhanced the intelligence.

### *Outcome measures*

*Main outcome measures:* The scores of the psychomotor development index (PDI), mental developmental index (MDI), National Institutes of Health Stroke Scale (NIHSS) and Activities of Daily Living (ADL) were the main outcome measures.

**PDI and MDI scores:** The PDI and MDI scores were compared between the two groups. The

Bayley Scales of Infant Development were applied to measure the PDI and MDI scores [17]. The Motor Scale of the Bayley Scales of Infant Development incorporated 81 items (e.g., laying prone head up, sitting, standing, walking, turning over, and running) with separate assessments of gross motor and fine motor ability. Besides, the Mental Scale of the Bayley Scales of Infant Development included 163 items (e.g., discriminating shapes, building blocks, and placing shaped boards) to assess sensorimotor ability. The maximum score of the Bayley Scales of Infant Development was 100 points. The higher the score is, the better the intelligence function is.

**NIHSS scores:** The NIHSS scores were compared between the two groups. The NIHSS was applied to measure 11 items of neurological function, including consciousness, gaze, visual field, facial paralysis, upper and lower limb movement with a score ranging from 0 to 42 [18]. The lower the score is, the better the neurological recovery of the patients is.

*Secondary outcome measures:* The incidence of cerebral palsy (CP) and scores of the developmental quotient (DQ) and Activities of Daily Living (ADL) were compared.

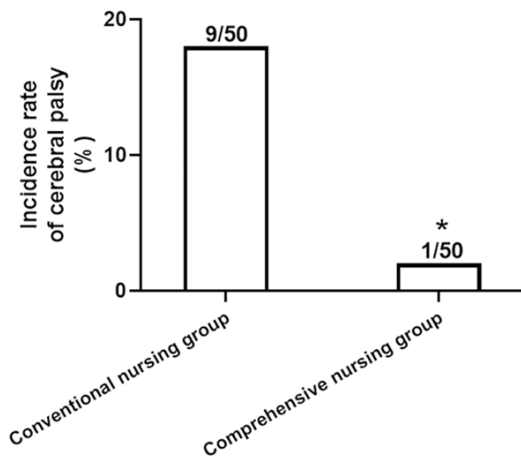
**Incidence rate of CP:** The incidence rates of CP were compared between the two groups. According to the assessment criteria, severe CP was confirmed when the patients present no active grasping, crawling, and walking with MDI scores of <50; moderate CP was confirmed when the patients present gross grasping with poor performance of pinching motions, walking with abnormal posture, and no crawling and standing by holding furniture with MDI scores of 50-70; mild CP was confirmed when the patients present poor performance of pinching of the index finger and the thumb, normal climbing, and walking by holding furniture with abnormal posture with MDI scores of >70 [19].

**DQ scores:** The DQ scores were compared between the two groups. The DQ of each group was calculated by Gesell Developmental Schedules that included adaptive behavior, gross motor, fine motor, language and personal-social behavior [20]. Developmental quotient (DQ) = development age/chronological age × 100.

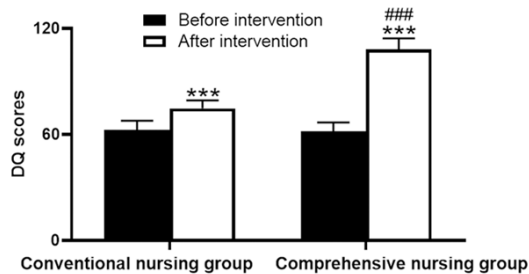
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**Table 1.** Comparison of baseline information

Factors	Experimental group (n=50)	Control group (n=50)	T/ $\chi^2$	P
Male/Female (n)	34/16	32/18	0.178	0.673
Average age (years)	5.4±0.5	5.6±0.7	1.644	0.103
Body mass (kg)	2.3±0.4	2.4±0.5	1.104	0.272
Disease course (h)	8.3±0.9	8.1±0.7	1.240	0.217
Injury type				
Primary TBI	30	28	0.164	0.685
Secondary TBI	20	22		



**Figure 1.** Comparison of the incidence rate of CP. Compared with the conventional nursing group, \*P<0.05.



**Figure 2.** Comparison of the DQ scores. Compared with pre-intervention, \*\*\*P<0.001; Compared with the conventional nursing group, ###P<0.001.

**ADL scores:** The ADL scores were compared between the two groups. The ADL scale was applied to assess the children's daily living ability, totally 9 items, such as eating, dressing, undressing, toileting, and walking [21]. Each item was divided into four grades ranging from 0 to 3 according to the completion rate, representing "dependence" (0 point), "moderate difficulty" (1 point), "slight difficulty" (2

points), and "independence" (3 points) with a maximum score of 27 points. The higher the score is, the better the children's daily living ability is.

## Statistical analysis

Data analyses were performed with the SPSS 21.0 software package. The measurement data were expressed as mean ± standard deviation ( $\bar{x} \pm sd$ ). Independent t-test was adopted for comparison between the

two groups and the paired t-test was adopted for comparison before and after intervention within the same group. Chi-square test ( $\chi^2$  test) was adopted for comparison between the two groups as to enumeration data expressed as the percentage or case (n). P<0.05 was considered statistically different.

## Results

### Comparison of baseline information

As shown in **Table 1**, there was no significant difference in the age, disease course, sex, body mass, and injury type between the two groups (P>0.05), suggesting that the two groups were comparable.

### Comparison of the incidence rate of CP

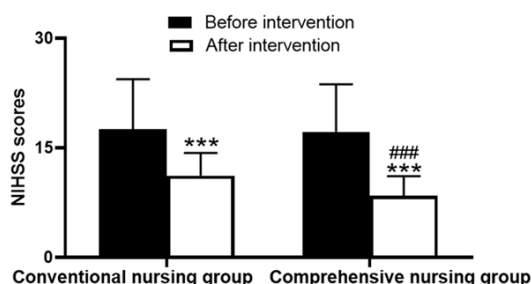
In the comprehensive nursing group, there was one case of mild CP, and no cases of moderate CP and severe CP with the incidence rate of 2% (1/50). In the conventional nursing group, there were six cases of mild CP, two cases of moderate CP and one case of severe CP with the incidence rate of 18% (9/50). It was found that the incidence rate of CP in the comprehensive nursing group was much lower than that in the conventional nursing group ( $\chi^2=5.005$ , P=0.025). See **Figure 1**.

### Comparison of the DQ scores

Before the intervention, there was no significant difference in the DQ scores between the two groups (62.4±5.3 vs 61.8±4.9, t=0.588, P=0.558). After the intervention, the scores of both groups were significantly increased (P<0.001), while the DQ score in the comprehensive nursing group was significantly higher than that in the conventional nursing group (74.8±4.5 vs 108.1±6.2, t=30.74, P<0.001). See **Figure 2**.

**Table 2.** Comparison of the PDI and MDI scores

Groups	PDI score		t	P	MDI score		t	P
	Before intervention	After intervention			Before intervention	After intervention		
Control group	69.5±10.1	82.2±12.7	5.534	<0.001	70.1±9.4	87.9±10.9	8.745	<0.001
Experimental group	70.6±10.8	95.6±13.1	10.410	<0.001	71.2±9.8	96.1±11.8	11.480	<0.001
t	0.526	5.193			0.572	3.609		
P	0.600	<0.001			0.568	<0.001		



**Figure 3.** Comparison of the NIHSS scores. Compared with pre-intervention, \*\*\*P<0.001; Compared with the conventional nursing group, ###P<0.001.

*Comparison of the PDI and MDI scores*

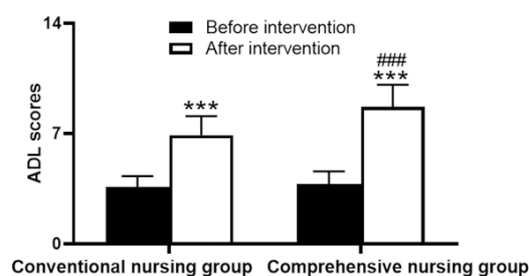
Before the intervention, there was no significant difference in the PDI (t=0.526, P=0.600) and MDI (t=0.572, P=0.568) scores. After the intervention, the PDI and MDI scores of both groups were significantly increased (P<0.001), while the PDI and MDI scores in the comprehensive nursing group were much higher than those in the conventional nursing group (P<0.001). See **Table 2**.

*Comparison of the NIHSS scores*

Before the intervention, there was no significant difference in the NIHSS scores (17.5±6.9 vs 17.2±6.5, t=0.224, P=0.824). After the intervention, the NIHSS scores of the two groups were significantly decreased (P<0.001), while the NIHSS score in the comprehensive nursing group was much lower than that in the conventional nursing group (11.2±3.1 vs 8.4±2.7, t=4.816, P<0.001). See **Figure 3**.

*Comparison of the ADL scores*

Before the intervention, there was no significant difference in the ADL scores (3.6±0.7 vs 3.8±0.8, t=1.330, P=0.187). After the inter-



**Figure 4.** Comparison of the ADL scores. Compared with pre-intervention, \*\*\*P<0.001; Compared with the conventional nursing group, ###P<0.001.

vention, the ADL scores of both groups were increased significantly (P<0.001), while the ADL score in the comprehensive nursing group was much higher than that in the conventional nursing group (6.9±1.2 vs 8.7±1.4, t=6.903, P<0.001). See **Figure 4**.

**Discussion**

Traumatic brain injury is common in pediatrics. Although the symptoms of traumatic brain injury may not show up at an early stage, more severe injuries will be caused with the children's growth and development. In severe cases, cerebral palsy occurs with a high disability rate, affecting the prognosis of the children. To reduce the developmental disorders impacting on intelligence and motor caused by TBI, early diagnosis and intervention should be performed in the children [22]. At present, the clinical treatment includes nourishing the nervous system, reducing intracranial pressure, delivering hyperbaric oxygen therapy, and maintaining a stable internal environment. Besides, nursing care combined with the treatment can also improve the clinical efficacy [23]. With the change of nursing concepts and models, medical and nursing quality has become increasingly valuable in recent years for improving clinical effects [24].



## Comprehensive nursing intervention in patients with traumatic brain injury

It is shown that comprehensive nursing is an all-round nursing model with high quality that has received increasing attention [25]. A study of comprehensive nursing for cancer patients indicated that comprehensive nursing could significantly improve the patients' compliance, reduce the negative emotions caused by cancer, and improve the symptoms, quality of life as well as mental health, ultimately leading to satisfactory results for the patients [26]. In the study, this new model provided health guidance, complication nursing, psychological nursing, diet nursing and rehabilitation nursing for children with TBI. The results revealed that the incidence rate of CP in the comprehensive nursing group was much lower than that in the conventional nursing group after receiving comprehensive nursing, suggesting that comprehensive nursing is of high quality to enhance the nursing care and prognosis of children with TBI, which were consistent with the results reported by Cook et al. [27].

Pediatric TBI is an important factor that affects children's intellectual and motor development. In order to facilitate recovery in the children, this study used comprehensive nursing intervention. The results showed that compared with the conventional nursing group, the scores of the DQ, PDI, and MDI of the comprehensive nursing group were significantly increased, while the NIHSS scores were significantly decreased, indicating that comprehensive nursing model can effectively improve the children's neurological function, contributing to their intellectual and motor development. This finding is probably observed because that the model stimulated the development of brain cells and proliferation of glial cells, thus promoting the mental development of the children; at the same time it restored the energy metabolism of nerve cells, and reduced the necrosis of brain cells, thus accelerating nerve repair. A study of rehabilitation reported that intelligence training enhanced the intelligence of children with CP [28]. Eytan et al. showed that the rehabilitation training in children with TBI could improve the neurological function to some extent, contributing to their physical and mental development [29].

Activities of daily living are the most basic and common activities that people must repeat every day, which will become more difficult for

children with TBI since their daily living abilities were severely affected [30]. In addition, the loss of daily living abilities can further undermine the self-confidence and self-esteem of the children. As a result, maximizing their recovery of activities of daily living has become one of the important rehabilitation tasks. In this study, the results identified that the ADL score of the children in the comprehensive nursing group was much higher than that in the conventional nursing group, suggesting that the comprehensive nursing intervention can significantly improve the daily living abilities of children with TBI, which were consistent with the results from the study of Olver et al. [31]. The reason may be that the diet nursing improved the physical quality; the psychological nursing relieved the anxiety and fear of the children and their families, as well as improved the compliance and initiative of the children; the complication nursing enhanced the confidence of the children's families, and the rehabilitation training stimulated the children's potential of autonomous movement.

In conclusion, comprehensive nursing intervention meets the needs of children with TBI, can effectively improve their intellectual and motor development, reduce the incidence of CP, and ameliorate the neurological function and daily living ability, which is worth being promoted in the clinical care. However, our study also has several limitations, such as its small single-center study, lack of long-term follow-up results and classification comparisons, and short-term nursing intervention. Therefore, we will use larger sample sizes of multi-center randomized controlled trials with long-term follow-up so as to get a more precise conclusion in the future.

### Disclosure of conflict of interest

None.

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