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Original Article

Application of Omaha system-based extended care in children with severe viral encephalitis and limb hypofunction

Lili Sun[1*], Demiao Yang[2*], Sisi Shao[3], Li Zhang[2], Lili Kong[4]

[1]Department of Otorhinolaryngology, Affiliated Hospital of Weifang Medical University, Weifang, Shandong Province, China; [2]Supply Room, Departments of [3]Ophthalmology, [4]Pediatrics, Shandong Zaozhuang Maternity and Child Health Care Hospital, Zaozhuang, Shandong Province, China. [*]Equal contributors and co-first authors.

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Abstract: Objective: To explore the effect of Omaha system-based extended care in children with severe viral encephalitis (SVE) complicated with limb hypofunction. Methods: In this prospective study, 82 children with SVE complicated with limb hypofunction were selected and divided into two groups according to a random number table method: Omaha group (n=43, Omaha system-based extended care) and control group (n=39, routine extended care). The following indicators between the two groups were compared, including total nursing effectiveness, disability rate, recovery time of limb disorders, nursing satisfaction, Fugl-Meyer assessment (FMA) scores at hospital discharge (before nursing), 1 month and 3 months after hospital discharge (after nursing), and Pediatric Quality of Life Inventory (PedsQL™ 4.0) Generic Core Scale scores. Results: Children in the Omaha group had significantly higher nursing effectiveness compared with the control group (88.37% vs. 69.23%, P<0.05), lower disability rate (4.65% vs. 20.51%, P<0.05), shorter recovery time of limb disorders (11.46±2.78 d vs. 16.33±3.87 d, P<0.0001), and higher item scores and total scores of nursing satisfaction (service attitude, professional skills, health education, psychological counseling, and case management) (all P<0.0001). FMA scores in the two groups at 1 month and 3 months after nursing were increased compared with those before hospital discharge (all P<0.05), and FMA scores at all stages after nursing in the Omaha group were better than those in the control group (all P<0.01). Physiology, emotion, society, role and total scores of PedsQL™ 4.0 in the two groups were increased at 1 month and 3 months after nursing (all P<0.05), and each score at all stages after nursing in the Omaha group was higher than that in the control group (all P<0.05). Conclusion: Omaha system-based extended care can improve the motor function and quality of life of children with SVE complicated with limb hypofunction, effectively control the disability rate, and increase nursing satisfaction of children's families; all of which are worthwhile to popularize and apply.

Keywords: Omaha system, extended care, severe viral encephalitis, limb function, quality of life

Introduction

Severe viral encephalitis (SVE) is a central nervous system infectious disease caused by enterovirus, herpes simplex virus and other common infectious viruses [1]. When SVE occurs in children, pathological changes are manifested as brain parenchyma necrosis, malacia or hemorrhage, which further triggers obstacles to limb movement, language function weakening, secondary epilepsy and other sequelae; severe SVE can lead to mental retardation, acroparalysis etc., with a disability rate as high as 20% [2]. The treatment of SVE is usually carried out within the hospital, and routine in-hospital care is given during the treatment. However, the critical period for disease recovery is 1-3 months after hospital discharge. Therefore, it is vital to treat patients with timely and effective extended care when the care is transferred from the hospital to the home [3].

The Omaha system is a simplified standardized nursing language system, which has been developed and improved since it was established in the United States in 1975, and has been recognized and proved by many service institutions in many countries for its scientific-

ness, effectiveness and applicability [4]. In addition to clinical nursing, the areas of application after its introduction in China include education, scientific research and others. At present, the Omaha system is mostly used for the nursing of patients with chronic diseases or community patients in clinical practice, while it is seldom used for the nursing of pediatric diseases. Previous study has found that when the Omaha system is applied to diseases that require extended care, it can improve the overall nursing for patients and their quality of life [5]. Although the survival rate of children with SVE increases with the development of the level of intensive care medicine in China, it is still a long way to recover from sequelae after treatment; this is an urgent and difficult problem to be solved in clinical nursing of this disease [6]. In view of the particular stages of the recovery of children with SVE, Omaha system-based extended care was applied to 3-month out-of-hospital nursing for children in this study, to explore the effect of this nursing model on prognostic recovery in SVE children with motor dysfunction.

Materials and methods

General data

In this prospective study, 82 children with SVE complicated with limb hypofunction who were admitted to Shandong Zaozhuang Maternity and Child Health Care Hospital from June 2017 to May 2019 were selected and divided into two groups according to a random number table method: Omaha group (n=43, Omaha system-based extended care) and control group (n=39, routine extended care). This study was approved by the Ethics Committee of Shandong Zaozhuang Maternity and Child Health Care Hospital.

Inclusive criteria: Diagnostic criteria for SVE in *Pediatrics Ninth Edition* published by the People's Medical Publishing House were met [7]; children were accompanied by limb hypofunction, with the Fugl-Meyer assessment (FMA) score of <50; children were 2-11 years old; children's families had normal communication skills and no dyslexia; children's families agreed and signed the informed consent form.

Exclusive criteria: Children were complicated with other central nervous system diseases besides SVE; children had congenital disease or other chronic progressive diseases.

Methods

Children in the control group were given medication guidance and precautions at hospital discharge and received routine extended care after hospital discharge; regular telephone follow-up began at 1 week after hospital discharge to follow the current physical symptoms, rehabilitation status, diet and daily activities of children, and health guidance was given and recorded according to the specific conditions. Home visits were arranged and recorded at 1 month after hospital discharge.

Children in the Omaha group received Omaha system-based extended care in addition to care received in the control group. Details were as follows.

Establishment of Omaha nursing team

The team members included a chief physician, a head nurse, a nursing postgraduate student, a psychotherapist, a physical therapist, and several clinical nurses. All team members had more than 5 years of work experience in pediatrics except the nursing postgraduate. All team members were trained and passed relevant examinations. The training methods included expert instruction and online video courses.

Nursing problems classification

At 3 d before hospital discharge, children were assessed by reference to environment, social psychology, physiology, and health behavior of the Omaha system, including a total of 42 guidance survey questions; according to the specific symptoms of children after assessment, the nursing problems were determined and the intervention direction was formulated [8]. For children facing multiple nursing problems at the same time, Maslow's hierarchy of needs was adopted according to the individual needs and symptoms of children, to prioritize each nursing problem before intervention.

Development of intervention measures

Based on the nursing process of the Omaha system, the above nursing problems were subclassified into 76 intervention directions in

terms of four nursing practices: health education guidance and consultation, treatment procedures, case management and monitoring [9]. Then intervention directions were summarized and adjusted to formulate an extended care plan suitable for SVE children in our hospital. Details were as follows.

On the day of hospital discharge, health records of all children were completed, including the time of first onset, the time of first diagnosis, prodromal symptoms, all inspection reports and nursing measures. Discharge instruction was then performed through multimedia, and the video presentation content included routine symptom identification and management, medication guidance, and precautions of diet, exercise and rest. The families were informed to record the health status of children on time at home for doctor's review at the subsequent visit.

The physical therapist instructed the families to massage children's joints by slow push and pull from top to bottom and guided the children to slowly stretch their limbs. The families were guided to massage children's Baihui, Fengchi and Zusanli points for smooth blood circulation of limbs and prevention of contracture of joints. Meanwhile, the children were guided to carry out joint movement of the injured limb; the children with level I movement disturbance performed passive motion; the children with level II and III performed active movement with assistant passive motion; the children with level IV performed impedance movement. Children were massaged 5-8 times/d and exercised 4-6 times/d. Each massage and exercise were no less than 15 min and no more than 30 min.

At the 1st week after hospital discharge, intervention directions were formulated based on children's main nursing problems and symptoms. The physical therapist made the rehabilitation program, and the psychotherapist carried out psychological nursing in real time. Details were shown in **Table 1**.

At the 3rd week after hospital discharge, a further consultation in the clinic was arranged for the children to carry out routine child health care and record their growth and development. A physical examination involving the nerve was performed by the chief physician.

At the 1st month after hospital discharge, a home visit was performed to provide familial guidance face to face. The results of measured items within 1 month were assessed, such as the scores of motor function and quality of life. The feasibility of current nursing pattern, whether to continue the plan, and whether previous nursing problems had been solved were weighed. The nursing effect at this stage was evaluated. If other nursing problems appeared, a corresponding intervention strategy was formulated according to the children's symptoms.

At the 2nd month after hospital discharge, nursing continued. Telephone follow-up or home visit was carried out to record the current health status of children, track nursing implementation of children's families and determine nursing progress.

At the 3rd month after hospital discharge, the above nursing process were continued, and the final nursing effect was assessed.

Outcome measurements and evaluation criteria

The scale evaluators in the team collected each indicator by questioning the study subjects before hospital discharge or at 1 month and 3 months after hospital discharge. The collection was carried out strictly according to the specific indicator evaluation period. The collection time of each child was not less than 20 min, and the questionnaire was collected on site. Forty-three copies of each questionnaire were collected from 43 children in the Omaha group, without anyone dropping out nor lost to follow-up.

Limb motor function scoring

Limb motor function was evaluated by using the FMA scale, with a maximum score of 100, including 50 items (33 items for upper limb function, and 17 items for lower limb function) each item having 2 scores [10]. The total score was the sum of each item score. A FMA score of less than 50 indicated severe movement disturbance (level I); a score of 50-84 indicated apparent movement disturbance (level II); a score of 85-95 indicated moderately apparent movement disturbance (level III); and a score of 96-99 indicated mild movement disturbance (level IV).

Table 1. Main nursing problems and intervention directions of children in the Omaha group

Classification	Nursing problems	Main symptoms and signs	Intervention directions
Environment	Sanitary condition of residence	1. Poor and humid dwelling environment with dead air 2. Interior structure and decoration with potential safety hazards	1. Keeping the dwelling environment clean and tidy, regular indoor air ventilation, and regular sun exposure 2. Removing the obstacles to ensure no potential safety hazards indoors and around
Physiology	Nerve-muscle-skeleton	1. Weak muscle strength, joint movement disorder, and paralysis of one lower limb	1. Regular massage, and keeping limb joint movement
Social psychology	1. Mental status 2. Social activity	1. Emotional instability, easy to be agitated, anxiety, and obvious fear 2. Delirium, and unconsciousness 3. No interests and hobbies, un-sensible social activities, and limited role function	1. Psychological nursing 2. Further consultation as requested, and symptomatic treatment 3. Encouragement and support from the families, and training coping skills
Health behavior	1. Health education 2. Daily habits	1. Lack of awareness of the disease, and failed to follow the doctor's advice 2. Sleep insufficiency 3. Eating disorder, and insufficiency of nutrient intake	1. Continuous education of health knowledge, and follow up and return visit 2. Keeping in quiet and comfortable status 3. Strengthening diet management

Table 2. Comparison of general data between the two groups ($\bar{x}$ ± sd, n/%)

	Control group (n=39)	Omaha group (n=43)	χ^2/t	P
Gender			0.084	0.773
Male	23 (58.97)	24 (55.81)		
Female	16 (41.03)	19 (44.19)		
Age (year)	7.7±2.1	7.8±2.6	0.190	0.850
Course of disease (day)	6.51±1.77	6.23±1.09	0.852	0.397
FMA scores (score)	41.45±7.23	41.98±6.34	0.354	0.724
Swallowing dysfunction	6 (15.38)	8 (18.60)	0.150	0.670

Note: FMA, Fugl-Meyer assessment.

Nursing effectiveness, disability rate and recovery time of limb disorders

Nursing effectiveness referred to the FMA scores that rose from level I to level II and above. Disability rate included the incidences of mental retardation, paralysis of one side of the body and secondary epilepsy.

Quality of life scoring

Pediatric Quality of Life Inventory (PedsQL™ 4.0) Generic Core Scale - Chinese Version was used to evaluate the quality of life [11]. This scale, developed by the research team was led by professor Vami J.W of the California Children's Hospital and Health Center in San Diego, USA; and is suitable for systematic measurement of health-related quality of life in children aged 2 to 18. In China it is often used to evaluate the quality of life of children with various acute and chronic diseases. Cronbach's α was 0.74-0.82. This scale included four dimensions of physiology, emotion, society, role and overall situation and was filled in by children's families. Each dimension scored 0-100, and the total score was the mean value of each dimension score. The score was proportional to the quality of life.

Nursing satisfaction of the families

The hospital-made nursing satisfaction evaluation form (reliability: 0.783, validity: 0.861) was used, including 5 aspects: service attitude, professional skill, health education, psychological counseling and case management, with a maximum score of 100. This form included 20 questions, with a score of 1-5 for each question. The score was proportional to the degree of satisfaction.

Statistical analysis

All data were analyzed by SPSS 21.0 professional statistical software. The measurement data were shown as mean ± standard deviation ($\bar{x}$ ± sd) and analyzed by independent-samples t test (expressed as t). The enumeration data were shown as n/% and analyzed by chi-square test and Fisher's exact test (expressed as χ^2). P<0.05 indicated a significant difference.

Results

Comparison of general data

There were no differences in general data between the two groups (all P>0.05, **Table 2**).

Comparison of nursing effectiveness, disability rate and recovery time of limb disorders

Children in the Omaha group had significantly higher nursing effectiveness (88.37% vs. 69.23%, χ^2=4.560, P=0.033), lower disability rate (4.65% vs. 20.51%, χ^2=4.805, P=0.028), and shorter recovery time of limb disorders (P<0.0001, **Table 3** and **Figure 1**) compared with the control group.

Comparison of FMA scores before nursing and at different stages after nursing

The FMA scores at 1 month and 3 months after nursing were higher than those before nursing (all P<0.05). The FMA scores at each stage after nursing in the Omaha group were significantly higher than those in the control group (all P<0.01, **Table 4**).

Comparison of PedsQL™ 4.0 scores before nursing and at different stages after nursing

Physiology, emotion, society, role and total scores of PedsQL™ 4.0 significantly increased at 1 month and 3 months after nursing in the two groups compared with those before nursing (all P<0.05), and each item score at each stage after nursing in the Omaha group was significantly higher than that in the control group (all P<0.05, **Table 5**).

Table 3. Comparison of nursing effectiveness, disability rate and recovery time of limb disorders

Group	Nursing effectiveness (n, %)	Disability rate (n, %)				Recovery time of limb disorders (days)
		Epilepsy	Mental retardation	Paralysis	Total	
Control (n=39)	27 (69.23)	4 (10.26)	3 (7.69)	1 (2.56)	8 (20.51)	16.33±3.87
Omaha (n=43)	38 (88.37)	2 (4.65)	0 (0.00)	0 (0.00)	2 (4.65)	11.46±2.78
χ^2/t	4.560	0.948	3.433	1.116	4.805	6.509
P	0.033	0.330	0.064	0.291	0.028	0.000

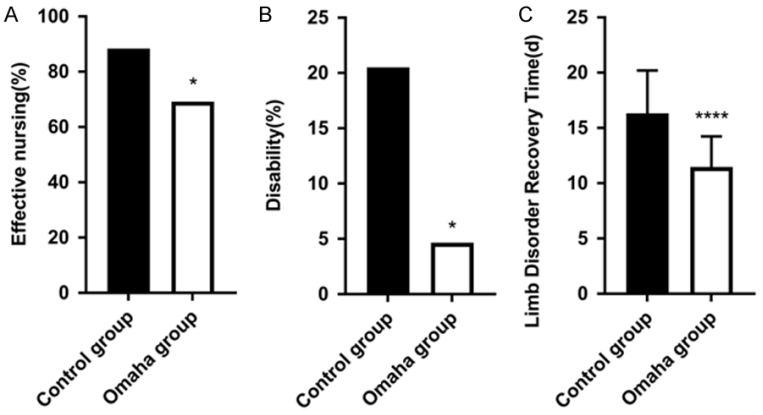

Figure 1. Comparison of nursing effectiveness, disability rate and recovery time of limb disorders. A. Comparison of nursing effectiveness between two groups. B. Comparison of disability rates between two groups. C. Comparison of recovery time of limb disorders between two groups. Compared with the control group, *P<0.05, ****P<0.0001.

Table 4. Comparison of FMA scores before nursing and at different stages after nursing ($\bar{x}$ ± sd)

Group	Before nursing	1 month after nursing	3 months after nursing
Control (n=39)	41.45±7.23	59.93±6.77*	65.09±7.12*
Omaha (n=43)	41.98±6.34	73.21±8.18#	79.44±8.40#
t	0.354	7.962	8.300
P	0.724	0.001	0.001

Note: Compared with before nursing in control group, *P<0.05; compared with before nursing in Omaha group, #P<0.05. FMA, Fugl-Meyer assessment.

Comparison of nursing satisfaction scores of families

Each item score and total scores of nursing satisfaction of families in the Omaha group were significantly higher than those in the control group (all P<0.0001), manifesting in service attitude (18.43±2.57 vs. 14.33±2.16), professional skill (18.25±2.33 vs. 15.32±2.78), health education (17.64±2.18 vs. 14.98±3.13), psychological counseling (17.78±2.75 vs. 13.71±2.67), case management (18.56±2.06 vs. 13.23±3.18), and total score (90.12±6.42 vs. 71.76±5.02, **Figure 2**).

Discussion

For SVE, there are no particular antiviral therapeutic measures currently. The main symptomatic treatments and supportive treatments can temporarily alleviate the deterioration of children's condition, but the high incidences of sequelae severely affect the healthy growth of children. Therefore, continuous nursing after hospital discharge is important for the rehabilitation and quality of life of the children [12, 13]. Extended care can give children comprehensive and coordinated individual nursing in different health care sites through a series of program designs [14]. However, the routine current out-of-hospital extended care in China is faced with many problems, such as shortage of nursing manpower, single nursing content, long course of nursing, and low compliance of children and their families, causing unsatisfactory nursing effects.

Previous studies have found that by the application of the Omaha system in clinical nursing, nursing problems in terms of children's family environment, social psychology, daily health behavior and others can be identified, and then intervention measures can be formulated [15, 16]. The advantage of the Omaha system is that it has a complete system process: problem classification, practice intervention, and effectiveness evaluation. Moreover, studies have proved that a retrospective analysis on the applicability of problem classification, the pertinence of practical measures and the rationality of effectiveness evaluation in the nursing cases

Table 5. Comparison of PedsQL™ 4.0 scores before nursing and at different stages after nursing ($\bar{x}$ ± sd)

Item	Time	Control group (n=39)	Omaha group (n=43)	t	P
Physiology	Before nursing	44.53±4.61	44.72±5.03	0.178	0.859
	At 1 month after nursing	46.21±4.12[a]	49.32±6.36[a]	2.651	0.010
	At 3 months after nursing	49.47±5.68[a,b]	54.27±7.01[a,b]	3.385	0.001
Emotion	Before nursing	58.23±5.06	57.74±6.74	0.369	0.713
	At 1 month after nursing	60.37±5.85[a]	63.56±6.39[a]	2.350	0.021
	At 3 months after nursing	63.89±6.13[a,b]	67.72±6.73[a,b]	2.684	0.009
Society	Before nursing	55.63±5.17	56.13±5.88	0.407	0.685
	At 1 month after nursing	57.98±5.07[a]	60.93±5.62[a]	2.486	0.015
	At 3 months after nursing	62.05±7.64[a,b]	66.23±8.30[a,b]	2.365	0.020
Role	Before nursing	39.88±4.22	38.13±4.09	1.906	0.060
	At 1 month after nursing	44.25±5.08[a]	47.34±4.97[a]	2.782	0.007
	At 3 months after nursing	49.23±5.52[a,b]	55.27±6.71[a,b]	4.425	0.000
Total score	Before nursing	48.99±5.01	50.10±5.33	0.969	0.336
	At 1 month after nursing	52.71±6.03[a]	56.42±6.77[a]	2.610	0.011
	At 3 months after nursing	58.19±7.21[a,b]	63.45±8.02[a,b]	3.111	0.003

Note: Compared with before nursing within the group, [a]P<0.05; compared with at 1 month after nursing within the group, [b]P<0.05. PedsQL™ 4.0: Pediatric Quality of Life Inventory Generic Core Scale.

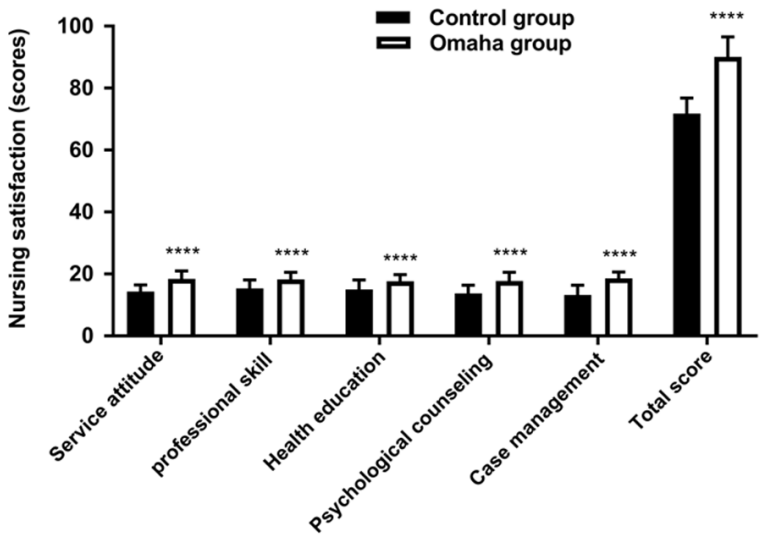

Figure 2. Comparison of family nursing satisfaction scores. Compared with the control group, ****P<0.0001.

and measures that are sorted out by the Omaha electronic software provides guidance for clinical nursing [17, 18]. Compared with North American nursing diagnosis, the Omaha system is more suitable for out-of-hospital case management and home visits in China. Therefore, it was applied in the extended care of children with SVE in this study.

In this study, a detailed and objective current condition of children in the Omaha group was obtained by analyzing their problems in physiology, environment and health behavior, and the corresponding intervention measures were formulated based on the intervention direction. Members in the nursing team performed their own duties; the psychotherapist provided professional psychological counseling, and the physical therapist was responsible for exercise rehabilitation guidance [19]. During the process, the nursing effect on children at different nursing stages was evaluated and adjusted, and the periodical effectiveness evaluation was the best evaluation of the children's improvement and nursing problems, thus thoroughly achieving the seamless extension of nursing from the hospital to home for children [20]. Throughout the nursing process, a harmonious doctor-nurse-patient interactive relationship was built; punctual telephone communication with high quality and regular home visits strengthened the sense of trust of families and ensured an easy and pleasant nursing process. In addition, the service concept of extended care enabled the sustainable implementation of nursing and

strengthened the compliance of children and their families to the rehabilitation treatment of diseases; punctual further consultation and regular examination promoted the recovery of illness and motor dysfunction. Studies found that when the vital signs of SVE children were stable, massaging the children at the critical period of disease recovery after discharge could reduce the incidences of joint stiffness and atrophy, and timely joint movement could prevent any secondary damage that was caused by secondary limb disorders such as foot drop [21-23]. In this study, the families of children in the Omaha group were instructed to massage their children from the day of hospital discharge, and the corresponding joint movement of the affected limb was performed according to children's level of motor dysfunction. Punctual telephone follow-up and face-to-face instruction at home visits from 1 month to 3 months after hospital discharge ensured the extensibility and continuous effectiveness of nursing intervention.

In this study, the FMA scores and PedsQL™ 4.0 scores of children in the two groups were higher at 1 month and 3 months after nursing than before hospital discharge, and both scores at each stage after nursing in the Omaha group were significantly higher than those in the control group. Meanwhile, the nursing effectiveness, disability rate and recovery time of limb disorders in the Omaha group were significantly better than those in the control group, and the nursing satisfaction of families in the Omaha group was significantly higher than that in the control group. This benefitted from the rigorous nursing process of Omaha system, which extended the nursing to the children's home and formulated a reasonable discharge schedule according to the actual situation of each child. Thus, children received enough nursing time. The combination with rehabilitation exercise reduced the occurrence of sequelae and improved nursing effectiveness while guaranteeing family satisfaction [24]. The advantage of this study was that this extended care guided nurses to carry out corresponding nursing work under the thinking mode of constructing nursing process in advance, avoiding problems such as insufficient pertinence of nursing plan and disconnection between nursing subjects and intervention measures, and providing evidence-based care of SVE children [25]. The shortcoming of this study was a small sample size. In future study, the sample size should be increased. In addition, it would be more comprehensive if the Omaha system was used to evaluate the recovery effects of children.

In summary, Omaha system-based extended care can improve the motor function and quality of life of SVE children complicated with limb hypofunction, effectively control the disability rate, and increase nursing satisfaction of children's families, which is worthwhile to popularize and apply.

Disclosure of conflict of interest

None.

Address correspondence to: Lili Kong, Department of Pediatrics, Shandong Zaozhuang Maternity and Child Health Care Hospital, Fuyuan Third Road, Xuecheng District, Zaozhuang 277100, Shandong Province, China. Tel: +86-0632-3187633; E-mail: konglilizz3h@163.com

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