RESEARCH ARTICLE

Application of novel nosocomial infection prevention and control combined with intestinal probiotics in children with hand, foot and mouth disease

Yuqiong Tao[1], Huibin Lu[2], Jinlian Huang[3], E Tang[4], Xiaoyan Xu[5], Jianhui Xie[6]*

Abstract

Objective: To explore the effect of novel nosocomial infection prevention and control combined with intestinal probiotics in children with hand, foot and mouth disease.

Methods: The randomised case-control study was conducted at the Hunan Children's Hospital, Changsha, China, from January 2022 to December 2023, and comprised of paediatric inpatients with hand, foot and mouth disease. The patients were randomised into control Group 1 receiving conventional treatment with basic nursing services, and intervention Group 2 receiving bacillus coagulans live tablets along with novel nosocomial infection prevention and control measures. The time of symptom resolution, fever resolution, length of hospital stay, clinical effect, serum inflammatory factors, immune function, incidence of adverse reactions, quality of life and parents' satisfaction with nursing were noted and compared between the groups. Data was analysed using SPSS 22.0.

Results: Of the 100 patients, 50(50%) were in Group 1; 25(50%) boys and 25(50%) girls with mean age 3.49±1.93 years. There were 50(50%) patients in Group 2; 26(52%) boys and 24(48%) girls with mean age 3.52±2.03 years ($p>0.05$). Compared to Group 1, patients in Group 2 had shorter time of symptom resolution, fever resolution, length of hospital stay, better total effective rate, lower frequency of adverse reactions and higher nursing satisfaction ($p<0.05$). After the intervention, improvements in serum inflammatory factors in Group 2 were more significant, the immune function indexes were higher, and the quality of life scores were better compared to Group 1 ($p<0.05$).

Conclusion: Novel nosocomial infection prevention and control combined with intestinal probiotics could promote the therapeutic effect of the children, improve the immune function, and promote the quality of life of children with hand, foot and mouth disease.

Keywords: Hand, foot and mouth disease, Nosocomial infection, Prevention and control, Intestinal probiotics, Immune function. (JPMA 75: S-130 [Suppl. 02]; 2025) **DOI: https://doi.org/10.47391/JPMA.SRPH-22**

Introduction

Hand, foot and mouth disease (HFMD) is a common disease in children. It is an acute infectious disease caused by the invasion and infection of enterovirus in children with weak autoimmune ability.[1] According to an epidemiological survey, HFDM mainly affects children aged 5 years and below.[2] After the onset, the children show symptoms, such as sore mouth, anorexia, low fever, small herpes in the hands, feet and mouth, etc., which pose a severe threat to health and quality of life (QOL) of the children.[3] The disease is characterised by insidious onset, rapid progression, and difficulty in quick cure.[4] In addition, some children are prone to aggravation after ineffective conventional treatment, and the disease turns into a critical type, which directly endangers the life of the children.[5] At present, there is no specific treatment for HFMD, and only anti-inflammatory, antiviral, antipyretic, analgesic and nutritional support therapies are used, but the efficacy is not good, and the symptoms of children cannot be quickly improved.[6] Therefore, it has become the focus of clinical attention to actively search for a new effective therapeutic method to treat HFMD.

Intestinal mucosa is the main way for enterovirus to invade the body, and the main place for enterovirus to proliferate.[7] As the harmful invader of HFMD infection, pathogenic bacteria in the intestinal are mutually restricted and dependent on intestinal probiotics to maintain the dynamic balance of microecology.[8] In addition, pathogenic bacteria in the intestine also proliferate in the intestines of children infected with HFMD, which cause the imbalance of the intestinal flora structure in children, and damage the intestinal mucosal barrier function, and further reduce the immune functions of thechildren.[9] Therefore, improving the intestinal mucosal barrier function and improving the immunity of children may contribute to the treatment of HFMD, and this theory also provides a novel idea for HFMD treatment.[10] Studies have shown that intestinal probiotics can elevate the intestinal immune function of the body, and have been gradually applied in the treatment of various intestinal infectious diseases, including HFMD, which is conducive to improving the therapeutic effect.[11]

[1-5]Department of Infection, Hunan Children's Hospital, Changsha 410007, Hunan, China; [6]Department of Nursing, Hunan Children's Hospital, Changsha 410007, Hunan, China.

Correspondence: Jianhui Xie. e-mail: 13975175737@163.com
ORICID: 0009-0001-7130-5755

As there is no specific drug for the treatment of HFMD in clinics, most of them are treated for symptoms, making effective nursing particularly important for the rehabilitation of children. It has been reported that in the treatment of children with HFMD, strengthening ward disinfection, skin cleaning and hygienic cleaning can effectively improve the curative effect.[12] The novel nosocomial infection prevention and control intervention nursing model has been applied in clinical practice recently, and in various departments.[13] However, its role in HFMD children remains not clear.

The current study was planned to explore the effect of novel nosocomial infection prevention and control combined with intestinal probiotics in children with HFMD.

Patients and Methods

The randomised case-control study was conducted at the Hunan Children's Hospital, Changsha, China, from January 2022 to December 2023, and comprised of paediatric inpatients with hand, foot and mouth disease. The patients were randomised using the random number table method[14] into control Group 1 and intervention Group 2. Those included were children aged <9 years with clinical manifestations, physical examination, influence examination and blood examination meeting the HMFD diagnostic criteria.[15] Those with other skin diseases or organ infections, having serious heart, brain, liver, kidney and lung diseases caused by unstable vital signs, critically ill children, those with mental illness and dysplasia, and children who had received antiviral or hormone therapy before admission were excluded. This study was approved by the Ethics Committee of Hunan Children's Hospital, and both parents of the child signed the informed consent form.

Group 1 patients were given conventional treatment, including antipyretic therapy, anti-inflammatory and antiviral therapy, rehydration therapy, water and electrolyte balance maintenance therapy, and dietary guidance. No vitamin supplement therapy was given.

Group 2 patients were treated with bacillus coagulans live tablets (Qingdao Donghai Pharmaceutical Co., Ltd., China) orally; 0.70 g/time to those aged <1 year, 1.05 g/time to those aged >1 year, 3 times per day.

Group 1 patients were provided with basic nursing services. The nursing staff actively monitored fever, drug use, and changes in the signs and symptoms of the children, and provided cooling intervention when needed.

Group 2 patients were given novel nosocomial infection prevention and control measures in addition to the basic nursing services. Specific nursing interventions included cooling nursing. Children with low or moderate fever were told to drink more water, and their body temperature was measured regularly. When the body temperature exceeded 38.5°C, the children were given drugs as per the doctor's advice, and physical cooling was provided if conditions permitted. The nurses evaluated the condition of the children after admission, and closely observed whether or not the children had severe warning signs. Children with fever were closely observed, and the nurses paid attention to whether or not the children had nerve involvement. The nurses paid special attention to medication and cooling intervention, and monitored the white blood cell (WBC) count of the children. If abnormalities were found, the nurses reported to the doctor to ensure timely treatment. Psychological support was also provided. Due to poor treatment compliance and poor control of their own emotions, the children were prone to various negative emotions, such as anxiety, temper and so on. In all such situations, the nurses were patient and kind, and took the initiative to care for and love the children. Besides, the nurses kept the children's mouth clean and hygienic, especially the children with oral herpes. In addition, the nurses paid attention to children's diet, making sure it was light. Meanwhile, the family members were advised to maintain the personal hygiene of the children, to ensure that the children could develop good living and healthy habits in order to promote a quick recovery.

Observation indicators were the same in both the study groups. The time of symptom resolution, fever resolution and length of hospital stay (LOS) were noted. The clinical effect of both the groups was analysed. Obvious effect meant that after 3 days of treatment, herpes significantly reduced, symptoms disappeared, fever subsided, and eating completely returned to normal. Effective treatment that after 6 days, the herpes of the child reduced, and most of them were dry and crusted, Besides, the fever had subsided, and the eating had recovered to some extent. Ineffective meant that after 6 days of treatment, the disease of the child did not improve, or even worsened, and the herpes could be broken, or even infected. Total effective rate was the combination of obvious effect and effective categories divided by the total cases and multiplied by 100 to express it in percentage terms.

Fasting venous blood samples of 3 ml were collected. Serum was obtained by centrifuge, and levels of interleukin-6 (IL-6) and IL-10 along with tumour necrosis factor-alpha (TNF-α) were examined using enzyme-linked immunosorbent assay (ELISA) (Shanghai Enzyme-Linked Biotechnology Company, Shanghai, China).

The levels of immunoglobulin (Ig)A, IgG and IgM were detected using a multifunctional flow cytometer

(CytoFLEX, Beckman Coulter, California, United States).

The frequency of adverse reactions, including diarrhoea, nausea, vomiting and rash, was recorded in both the groups.

The QOL of the children was evaluated using the Short Form-36 (SF-36) survey,[16] including physiological function, physical pain, mental health, emotional function, social function, health status, physical and vitality. The total score was 100, with higher score indicating better QOL.

The nursing satisfaction of children's parents was categorised as very satisfied, satisfied and dissatisfied. The nursing satisfaction rate was the combination of the first two categories divided by the total number of cases and multiplied by 100 to express it in percentage terms.

Data was analysed using SPSS 22.0. Measurement data was expressed as mean±standard deviation, and t-test was used for comparison. Counting data was expressed as frequencies and percentages, and chi-square test was used for comparison. P<0.05 was taken as statistically significant.

Results

Of the 100 patients, 50(50%) were in Group 1; 25(50%) boys and 25(50%) girls with mean age 3.49±1.93 years. There were 50(50%) patients in Group 2; 26(52%) boys and 24(48%) girls with mean age 3.52±2.03 years (p>0.05) (Table 1).

Compared to Group 1, patients in Group 2 had shorter time of symptom resolution, fever resolution, LOS (Figure 1), as well as better total effective rate (Table 2).

Serum inflammatory factors in both groups had no difference prior to intervention (p>0.05). After the intervention, TNF-α and IL-6 levels declined in both groups, but those in Group 2 were lower compared to Group 1 (p<0.05). IL-10 level elevated in both the groups post-intervention, but Group 2 level was higher compared to Group 1 (p<0.05) (Figure 2).

Immune function displayed no difference between the groups before the intervention (p>0.05). After the intervention, IgA, IgG and IgM levels were found elevated in both the groups, but Group 2 levels were higher compared to Group 1 (p<0.05) (Figure 3).

Table-1: Patient characteristics.

Items	Group 1	Group 2	x^2/t-test	p-value
	(n=50)	(n=50)		
Gender (male/female)	25/25	26/24	0.040	0.841
Mean age (years)	3.49±1.93	3.52±2.03	0.075	0.939
Mean course of disease (days)	2.13±0.78	2.16±0.81	0.188	0.850

Table-2: Intergroup comparison of clinical effects.

Groups	n	Obvious effect	Effective	Ineffective	Total effective rate
Group 1	50	20	20	10	40 (80.00%)
Group 2	50	27	21	2	48 (96.00%)
x^2					6.061
p-value					0.014

Table-3: Intergroup comparison of adverse reactions.

Groups	n	Diarrhoea	Nausea and vomiting	Rash	Total frequency rate
Group 1	50	3	3	3	9 (18.00%)
Group 2	50	0	1	1	2 (4.00%)
x^2					5.005
p-value					0.025

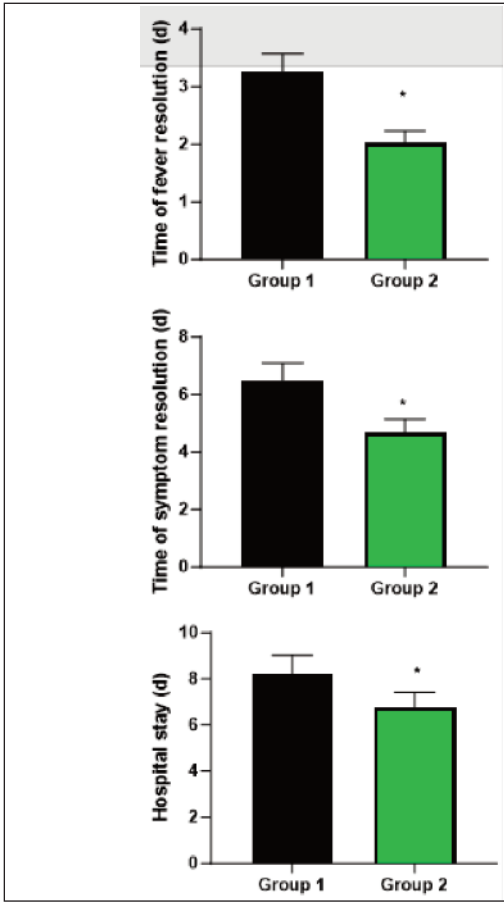

Figure-1: Time of symptom resolution, fever resolution and length of hospital stay in the two groups. *p<0.05.

Table-4: Intergroup comparison of nursing satisfaction.

Groups	n	Very satisfied	Satisfied	Dissatisfied	Total satisfaction rate
Group 1	50	23	18	9	41 (82.00%)
Group 2	50	26	22	2	48 (96.00%)
x^2					5.005
p-value					0.025

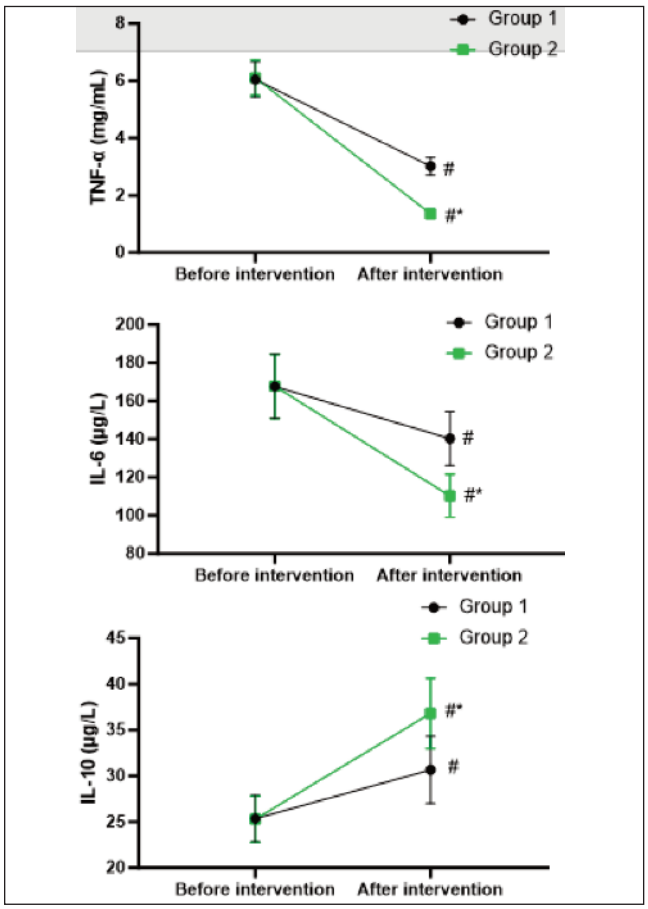

Figure-2: Serum inflammatory factors in the two groups.
*#p<0.05 vs before intervention, *p<0.05 vs control group.*

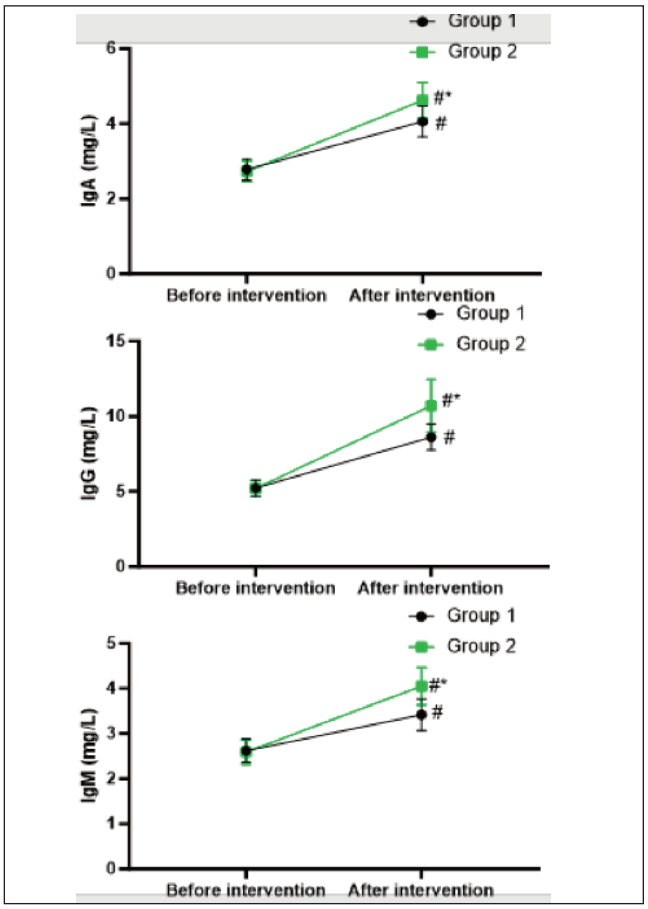

Figure-3: Immune function in the two groups.
*#p<0.05 vs before intervention, *p<0.05 vs control group.*

Further, Group 2 had fewer adverse reactions than Group 1 (p<0.05) (Table 3).

SF-36 scores showed no intergroup difference prior to intervention (p>0.05). After the intervention, all SF-36 dimensions were found elevated in both the groups, but those in Group 2 were better compared to Group 1 (p<0.05) (Figure 4).

Nursing satisfaction was significantly higher in Group 2 compared to Group 1 (p<0.05) (Table 4).

Discussion

HFMD is a disease caused by human infection with enterovirus.[17] The main transmission route is faecal-oral transmission, and its clinical characteristics are strong infectivity and rapid epidemic, which often involves the body's respiratory, nervous and other systems if the clinical treatment is improper. A delay in treatment is likely to lead to deterioration of the condition. Active treatment along with effective nursing interventions are extremely important.[18]

In routine nursing mode, due to the young age of the patients and their lack of self-care ability along with the low cognition level of most parents in relation to HFMD, potential risk factors are not avoided in the process of care, resulting in the progression of the disease into a severe phase.[19] The novel nosocomial infection prevention and control is a nursing intervention model that has been applied in clinical practice in recent years.[20] In the current study, the novel was used for children with HFMD from four aspects, including cooling nursing, severe warning, psychological support, and life intervention. Previous studies have shown that in the diagnosis and treatment of HFMD, cooling is the primary priority.[21] For children with persistent fever, unstable signs, and nervous system involvement, clinical healthcare workers need to increase the level of nursing intervention, and actively provide symptomatic relief. In addition, warning nursing, comprehensive nursing and continuous nursing aspects are all beneficial to effectively prevent the progression of the disease, and to promote the rehabilitation of children, as well as promote the treatment compliance of the children.[22]

Probiotics and bacteria in the intestinal tract play a role in

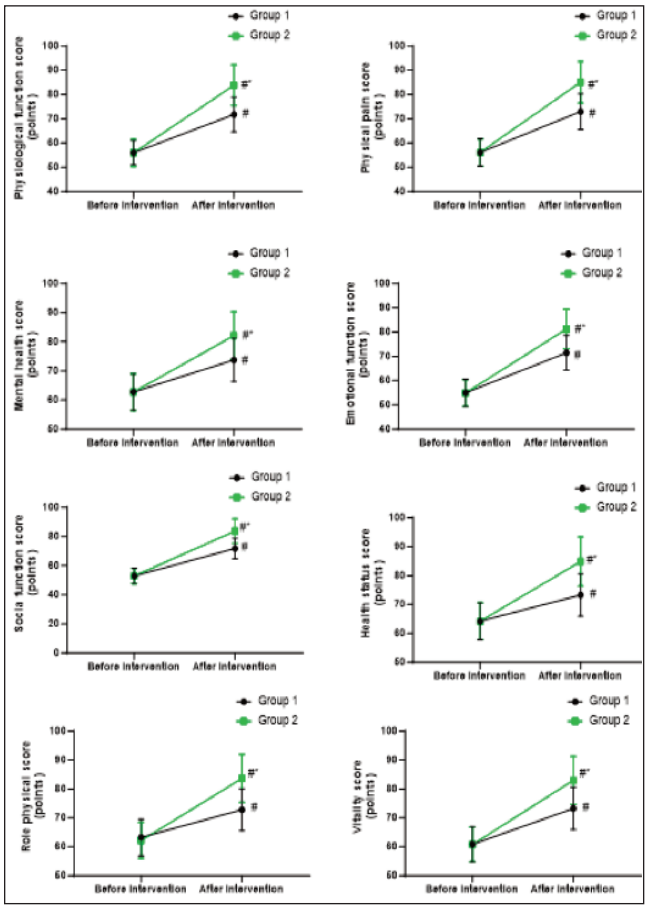

Figure-4: Immune function in the two groups.

*#p<0.05 vs before intervention, *p<0.05 vs control group.*

maintaining the ecological balance.[23] The occurrence of HFMD is due to the continuous proliferation of viruses in the intestinal tract, which eventually leads to the imbalance of intestinal flora, and the damage of the mucosal barrier to some extent. This spreads to the whole body through the blood.[24] Therefore, improving intestinal immunity can better treat HFMD.

Bacillus coagulans belongs to the intestinal lactic acid bacteria series, and is the original bacterial species of the intestinal tract. It has the ability to enhance immunity, has the effect of antagonising adenovirus, influenza A virus and other viral infections.[25] Bacillus coagulans can reduce the level of viruses entering the blood by inhibiting intestinal mucosal viruses, and can also secrete antibacterial coagulins to inhibit the reproduction of harmful bacteria, and reduce toxin synthesis.[26] At the same time, it can decompose polysaccharides into oligosaccharides, and promote the growth of lactobacillus, bifidobacterium and other beneficial bacteria in the intestine, which can rapidly improve the intestinal flora disorder and establish a biological intestinal protective barrier.[27]

In the current study, relative to Group 1, Group 2 had shorter time of symptom resolution, fever resolution and LOS, as well as better total effective rate, suggesting that novel nosocomial infection prevention and control combined with intestinal probiotics had a positive effect on treating children with HFMD, which was consistent with previous studies.[28,29]

Many inflammatory factors are involved in the course of HFMD.[30] Both IL-6 and IL-10 are interleukin-series factors that are mainly synthesised by B lymphocytes, mononuclear macrophages and T lymphocytes.[31] IL-6 can activate abnormal proliferation and differentiation of immune response cells, and overexpression can be seen in HFMD children.[32] IL-10 belongs to an anti-inflammatory factor, which can effectively inhibit inflammatory response.[33] IL-6 and IL-10 maintain a dynamic balance under normal conditions. In case of HFMD, the body is in a state of viral infection, and IL-10 expression is decreased due to the repression of viral infection, while IL-6 expression is increased, thus breaking the balance of inflammatory cytokine expression.[34] When the virus infection is effectively controlled, IL-10 expression increases, IL-6 expression decreases, and the normal balance is gradually restored.[35] TNF-α is an important inflammatory factor that is involved in many pathological injuries. It can improve the phagocytosis of neutrophils, induce fever by triggering immune response, induce the synthesis of acute time-tropic proteins in hepatocytes, and promote the increase of IL-6 expression.[36] The results of the current study indicated that after the intervention, TNF-α and IL-6 levels in Group 2 were lower relative to Group 1, while IL-10 level in Group 2 was higher compared to Group 1. Meanwhile, IgA, IgG and IgM levels in Group 2 were higher compared to Group 1. All these findings suggested that the novel nosocomial infection prevention and control combined with intestinal probiotics could inhibit inflammatory stress response, restore the balance mechanism between inflammatory factors and anti-inflammatory factors, and prevent excessive immune response, which was consistent with previous reports.[37,38]

Moreover, the current study indicated that compared to Group 1, patients in Group 2 had lower frequency of adverse reactions, higher SF-36 scores, and better nursing satisfaction, indicating that the novel nosocomial infection prevention and control combined with intestinal probiotics could reduce the adverse reactions and promote the QOL of HFMD children, in addition to resulting in the nursing satisfaction of the children's parents.

The current study has limitations as the sample size was not calculated which could have affected the power and generalisability of the findings.

Conclusion

Novel nosocomial infection prevention and control combined with intestinal probiotics could promote the therapeutic effect, improve the immune function, and promote the QOL of HFMD children.

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Conflict of Interest: None.

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