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Original Article

Effects of evidence-based nursing intervention on pain control and venipuncture quality in pediatric patients undergoing intravenous infusion: a retrospective study

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Abstract: Background: Intravenous infusion is one of the most common therapeutic procedures in pediatric clinical practice. However, the pain caused by the procedure often triggers strong stress responses in children and may even lead to resistance to treatment. This study aimed to investigate the effectiveness of evidence-based nursing for painless intravenous infusion in children. Methods: A total of 220 children who required intravenous infusion and were admitted to the Second People's Hospital of Hunan Province from June 2023 to December 2024 were retrospectively enrolled. According to the actual nursing regimen received, they were categorized into a control group (receiving conventional nursing, n=110) and an observation group (receiving evidence-based nursing, n=110). The nursing effects were compared between the two groups. Results: In the observation group, the onset of crying and pain face occurred later, with shorter durations, and lower FPS-R and FLACC scores compared to the control group (all $P<0.05$). The observation group also showed significantly higher rates of one-time successful puncture (89.1% vs. 71.8%), painless puncture (77.3% vs. 64.5%), and other puncture quality indicators, as well as lower rates of infusion complications (all $P<0.05$). Heart rate and mean arterial pressure were significantly lower in the observation group ($P<0.05$). Both child compliance (89.1% vs. 76.4%) and parental satisfaction (94.5% vs. 80.9%) were significantly higher in the observation group ($P<0.05$). Conclusion: Application of evidence-based nursing intervention in children undergoing intravenous infusion can effectively reduce pain, improve patient compliance, and decrease stress response, thereby enhancing puncture and infusion quality.

Keywords: Evidence-based nursing, intravenous infusion, pain, compliance, satisfaction

Introduction

Intravenous infusion, one of the most commonly used routes of drug administration in clinical practice, mainly uses the principles of atmospheric pressure and hydrostatic pressure to infuse sterile fluids, electrolytes, or medications into the vein of pediatric patients, useful for treating childhood diseases [1]. Due to the invasive nature of intravenous infusion, it not only triggers intense physiologic and psychologic stress responses in children, such as crying, agitation, tachycardia, and hypertension, but may also lead to negative emotions such as fear and anxiety toward medical procedures, resulting in long-term negative effects on subsequent treatment compliance [2, 3]. Furthermore, young children have poor tolerance to painful stimuli, and significant deficiencies in cognitive ability, self-control, and verbal communication skills. These not only increase the difficulty of nursing work but also reduce the success rate of venipuncture, increase the child's suffering from the process, and hinder the smooth progress of clinical treatment [4, 5]. Therefore, it is particularly important to alleviate children's pain during infusion and improve their compliance in clinical practice.

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Table 1. Comparison of general data between the two groups

Variable	Control group (n=110)	Observation group (n=110)	t/χ^2 value	*P* value
Age (years)	4.52±1.41	4.74±1.68	-1.052	0.294
Sex			0.018	0.892
Male	62 (56.4)	61 (55.5)		
Female	48 (43.6)	49 (44.5)		
Infusion days	5.03±0.35	5.07±0.40	-0.789	0.431
Disease type			1.994	0.736
Upper respiratory infection	29 (26.4)	27 (24.5)		
Pneumonia	25 (22.7)	25 (22.7)		
Urinary tract infection	21 (19.1)	23 (20.9)		
Gastrointestinal disease	18 (16.4)	19 (17.3)		
Others	17 (15.5)	16 (14.5)		
Infusion puncture site			0.236	0.627
Scalp vein	26 (23.6)	23 (20.9)		
Extremity vein	84 (76.4)	87 (79.1)		
Guardian's education level			0.101	0.951
Middle school or below	30 (27.3)	28 (25.5)		
High school or technical secondary	21 (19.1)	22 (20.0)		
College degree or above	59 (53.6)	60 (54.5)		

Current clinical interventions for pediatric intravenous infusion pain mainly include distraction techniques and application of topical anesthetics [6]. However, these methods are often applied in a fragmented manner, lacking standardized protocols. Moreover, the selection of specific measures relies on the subjective experience of nursing staff, while the influence of children's psychological factors and self-efficacy on treatment compliance tends to be overlooked, resulting in suboptimal overall treatment effectiveness. Evidence-based nursing is a new concept emerging from evidence-based medicine, whereby nursing staff integrate scientific research findings with clinical experience and the actual nursing needs of pediatric patients to guide clinical nursing decisions, and then implement nursing interventions [7]. Based on this, this study retrospectively analyzed the clinical data of pediatric patients receiving intravenous infusion in a certain hospital. By comparing data from children receiving evidence-based nursing versus conventional nursing, we explored the effects of evidence-based nursing interventions on pain control, puncture quality, and compliance in pediatric intravenous infusion, with the goal of promoting standardized development of pediatric pain management and improving the medical experience of children.

Materials and methods

General data

The sample size was calculated using the formula for comparison of two independent proportions: $n=(Z_{1-\alpha/2}+Z_{1-\beta})^2\times[p_1(1-p_1)+p_2(1-p_2)]/(p_1-p_2)^2$. For this two-sided test, $\alpha=0.05$ and $\beta=0.20$, giving $Z_{1-\alpha/2}=1.96$ and $Z_{1-\beta}=0.84$. Based on preliminary experimental data (n=30 per group), the one-time successful puncture rate was 70.0% in the control group and was expected to be 90.0% in the observation group. The calculated sample size was 82 cases per group. Accounting for a 20% dropout rate, the final sample size was determined as 110 cases per group. 220 children who required intravenous infusion and were admitted to Brain Hospital of Hunan Province from June 2023 to December 2024 were retrospectively enrolled. According to the actual nursing regimen received during their hospitalization, they were categorized into a control group (receiving conventional nursing) and an observation group (receiving evidence-based nursing), with 110 cases in each group. No significant differences were found in general data between the two groups ($P>0.05$), indicating comparability (**Table 1**). No missing data were present, as all data were collected from complete medical

records. This study was approved by the ethical committee of Second People's Hospital of Hunan Province, and informed consent from patients' families was waived due to the retrospective nature.

Inclusion criteria: ① Aged 3-12 years; ② Received intravenous infusion treatment in our hospital with duration >48 hours; ③ Possessed certain cognitive, comprehension, and communication abilities; ④ Intact local skin without ecchymosis.

Exclusion criteria: ① Combined with infectious diseases, coagulation disorders, phlebitis, etc.; ② Contraindications to infusion or drug allergies; ③ Unstable or critical condition.

Evidence-based nursing protocol

The control group received conventional nursing interventions. With parental accompaniment, the children's limbs were immobilized during intravenous infusion. During infusion, the children's condition was monitored, and any abnormalities were managed promptly.

The observation group received evidence-based nursing interventions. Prior to implementation, all participating nurses (n=8, all with at least 3 years of pediatric nursing experience) underwent a standardized training program consisting of 4 hours of theoretical instruction and 2 hours of hands-on simulation practice. Training content included: principles of evidence-based nursing, specific operational procedures for each intervention, communication skills with children and parents, and standardized use of pain assessment tools. A post-training assessment was conducted, and all nurses were considered qualified if they achieved a score of ≥85%. The specific interventions were as follows:

① Environmental care (implemented immediately upon the child's entry into the infusion room, lasting throughout the entire infusion process): Colorful cartoon pictures that children like were placed on the walls at a height of 80-120 cm above the floor, within the child's line of sight. Upon entering the infusion room, children were greeted warmly. Parents were introduced to the medical environment, including the location of the infusion chair, nurse call system, and restroom. The infusion room temperature was maintained at 22-26°C, with relative humidity of 50%-60%. Wall colors (light blue and light green) and facility configuration (child-sized chairs, age-appropriate toys) were selected based on children's preferences and needs.

② Psychological care (initiated before venipuncture and continuing until infusion completion): Before venipuncture (5-10 minutes prior): nurses used encouraging phrases such as "You are brave" or "You are doing great". Alternatively, the child's favorite cartoons were played on a tablet placed 50-60 cm from the child's eyes. For children who cried, material rewards (e.g., stickers, small toys worth <5 RMB) were given to improve their cooperation willingness. During venipuncture: Nursing staff used nonverbal communication, such as gently patting the forehead (3-5 times at 1-second intervals), maintaining soft eye contact, and providing patient verbal comfort ("It will be done soon", "You are doing so well"). During infusion: Family members were requested to accompany the child throughout the procedure. Nursing staff informed parents of the specific venipuncture plan (puncture site, anticipated number of attempts, alternative plan) before the procedure to gain their support and cooperation. Parents were also instructed to proactively adjust the child's clothing according to temperature changes.

③ Daily living care (completed before venipuncture): Before puncture, nurses talked with parents to determine whether the child had eaten within the previous 2 hours. Parents were informed that infusion on an empty stomach (fasting >4 hours) could cause discomfort, so they were advised to give the child some light food (e.g., crackers, milk) 1-2 hours before infusion to prevent gastrointestinal discomfort. Children who had fasted for >4 hours without contraindications were given 50-100 mL of warm water or milk.

④ Puncture and infusion care (during venipuncture and throughout infusion): Pre-puncture positioning: Children were placed in a comfortable position (semi-recumbent or supine, with the puncture limb supported and slightly abducted). The importance of protecting the puncture site was explained to children and parents using age-appropriate language. Distraction during puncture: Children's favorite cartoons or songs were played, beginning 2 minutes before puncture and continuing until

the needle was secured. The volume was set at 40-50 dB. Needle selection: Small-gauge venipuncture needles (24 G or 26 G) were chosen based on vein assessment to reduce pain. Puncture technique: During puncture, the child's pain sensitivity was taken into account. The needle was held in the right hand and inserted at a 30°-45° angle (increased from the traditional 20°) with fast, accurate, and stable movements to achieve one-time successful puncture whenever possible (target time from skin puncture to blood return <5 seconds), thereby avoiding multiple punctures that increase pain. If necessary (anticipated need for >48 hours of infusion or difficult venous access), intravenous indwelling catheters were used to prevent repeated punctures. During infusion: Nursing staff performed rounds every 30 minutes to check infusion drip rate (maintained at 20-40 drops/min for children aged 3-12 years unless otherwise specified) and needle leakage. For children with dry lips, parents were instructed to encourage fluid intake (5-10 mL every 15-20 minutes). Children were asked about any discomfort ("Does it hurt anywhere?" "Do you feel okay?"). If abnormal manifestations (swelling at the puncture site, crying, pallor) were observed, the attending physician was notified immediately and symptomatic management was provided. Fluid replacement: When changing fluids, the child's information was carefully checked using a two-person verification protocol (two nurses confirming the child's name and date of birth against the medical order) before proceeding with fluid replacement. Children and parents were instructed not to adjust the drip rate on their own.

⑤ Post-infusion care (immediately after infusion completion, lasting 5-10 minutes): After intravenous infusion was completed, nursing staff moistened the tape with a cotton swab soaked in 0.9% sodium chloride injection (for 10-15 seconds), thereby reducing pain caused by tape removal. Parents were instructed to apply pressure to the puncture site with a dry cotton ball for 5 minutes (using a timer to ensure accuracy) to prevent bleeding and avoid rubbing the puncture site. Nursing staff promptly praised the child for brave behavior ("You did such a great job!" "You were very brave!") and gave small gifts or stickers as rewards (one sticker per successful completion, up to 3 stickers per infusion course).

Observational indicators

Pain assessment: Pain intensity during venipuncture was assessed using the revised Wong-Baker Faces Pain Scale Revision (FPS-R). Scores ranged from 0 to 10 based on six facial expressions, with higher scores indicating greater pain perception [8]. The FLACC scale was used to assess children's pain manifestations after venipuncture (within 5 minutes after the procedure), including five items: crying, facial expression, legs, activity, and consolability, each scored 0-2, with a total score of 0-10. Higher scores indicated more obvious pain [9].

All scale evaluations were performed by two trained nurses who were blinded to the group allocation. Prior to the study, both nurses underwent standardized training on the use of FPS-R and FLACC scales, including case-based scoring exercises. The final score for each child was the average of the two nurses' independent ratings.

Stress response during puncture: Data on physiological findings, including heart rate and mean arterial pressure, were obtained from the inpatient nursing records. For each patient, the values recorded closest to the time of venipuncture, specifically within 15 minutes before or after venipuncture, were extracted and used as the representative stress response indicators.

Compliance: Compliance during puncture and infusion was evaluated [10]. Complete compliance: the child did not cry or struggle physically during puncture, remained relaxed; showed no agitation during infusion, and promptly expressed any discomfort. Partial compliance: the child struggled briefly without crying during puncture, and the puncture was successfully completed; during infusion, minor fidgeting occurred without affecting the infusion process, and crying or fidgeting when discomfort arose could be resolved with comfort from nursing staff and parents. Non-compliance: the child cried, struggled violently, or became agitated during puncture, greatly affecting the nurse's attempt and requiring multiple puncture attempts, or even resulting in failure to complete infusion, and requiring coercive measures. Total compliance rate = (complete compliance + partial compliance)/total cases × 100%.

Puncture and infusion quality: Puncture quality included one-time successful puncture rate, painless puncture rate, puncture without hematoma rate, fixation without loosening rate, and needle removal without ecchymosis rate [11]. Infusion quality included infusion extravasation rate, infusion air embolism rate, tubing detachment rate, and tubing kinking rate. Among these, the painless puncture rate was defined based on an objective composite standard: a score of ≤2 on the Wong-Baker FPS-R scale (indicating no or mild pain) combined with the absence of crying and physical struggling during the venipuncture procedure [12]. Two trained nurses who were blinded to group allocation independently evaluated this indicator. In case of disagreement, consensus was reached through discussion or a third-party arbitrator was consulted.

Satisfaction rate: A self-made satisfaction questionnaire was used to survey parents, covering items such as nursing attitude, efficiency, puncture technique, and nursing operational skills [13]. The total satisfaction score was 100, with higher scores indicating higher satisfaction with nursing work. Total scores: 85-100 = very satisfied, 60-85 = satisfied, 0-60 = dissatisfied. Satisfaction rate = (number of very satisfied + number of satisfied)/total cases × 100%. The Cronbach's alpha of this scale was 0.89, indicating good internal consistency.

Statistical analysis

SPSS 22.0 statistical software was used for data analysis. Measured data were expressed as mean ± SD, and intergroup comparisons were performed using independent samples t-tests. Counted data were expressed as rates (%), and intergroup comparisons were performed using chi-square (χ^2) tests. Multivariable logistic regression was performed to adjust for age, sex, disease type, puncture site, and guardian's education level. Dependent variables were one-time successful puncture, painless puncture, and total compliance. $P<0.05$ was considered significant.

Results

Comparison of pain-related reactions during puncture between the two groups

The onset time of crying and the appearance time of pain expression in the observation group were delayed compared with the control group ($P<0.05$). Compared to the control group, the durations of crying and pain expression in the observation group were significantly shortened ($P<0.05$), and the FPS-R score was significantly decreased ($P<0.05$) (**Figure 1**).

Comparison of FLACC scores between the two groups

Compared to the control group, the crying score, facial expression score, legs score, activity score, consolability score, and total FLACC score in the observation group were significantly decreased ($P<0.05$) (**Figure 2**).

Comparison of stress responses during puncture between the two groups

The heart rate and mean arterial pressure of children in the observation group were significantly lower than those in the control group ($P<0.05$) (**Figure 3**).

Comparison of compliance rates between the two groups

The total compliance rate in the control group was 76.4%, while that in the observation group was 89.1%. The total compliance rate in the observation group was significantly higher than that of the control group ($P<0.05$) (**Table 2**).

Comparison of puncture quality between the two groups

Compared to the control group, the one-time successful puncture rate, painless puncture rate, puncture without hematoma rate, fixation without loosening rate, and needle removal without ecchymosis rate in the observation group were significantly increased ($P<0.05$) (**Table 3**).

Comparison of infusion quality between the two groups

Compared to the control group, the infusion extravasation rate, infusion air embolism rate, tubing detachment rate, and tubing kinking rate in the observation group were significantly decreased ($P<0.05$) (**Table 4**).

Comparison of parent satisfaction with nursing care between the two groups

The total satisfaction rate in the control group was 80.9%, while that in the observation group was 94.5%. The total satisfaction rate in the

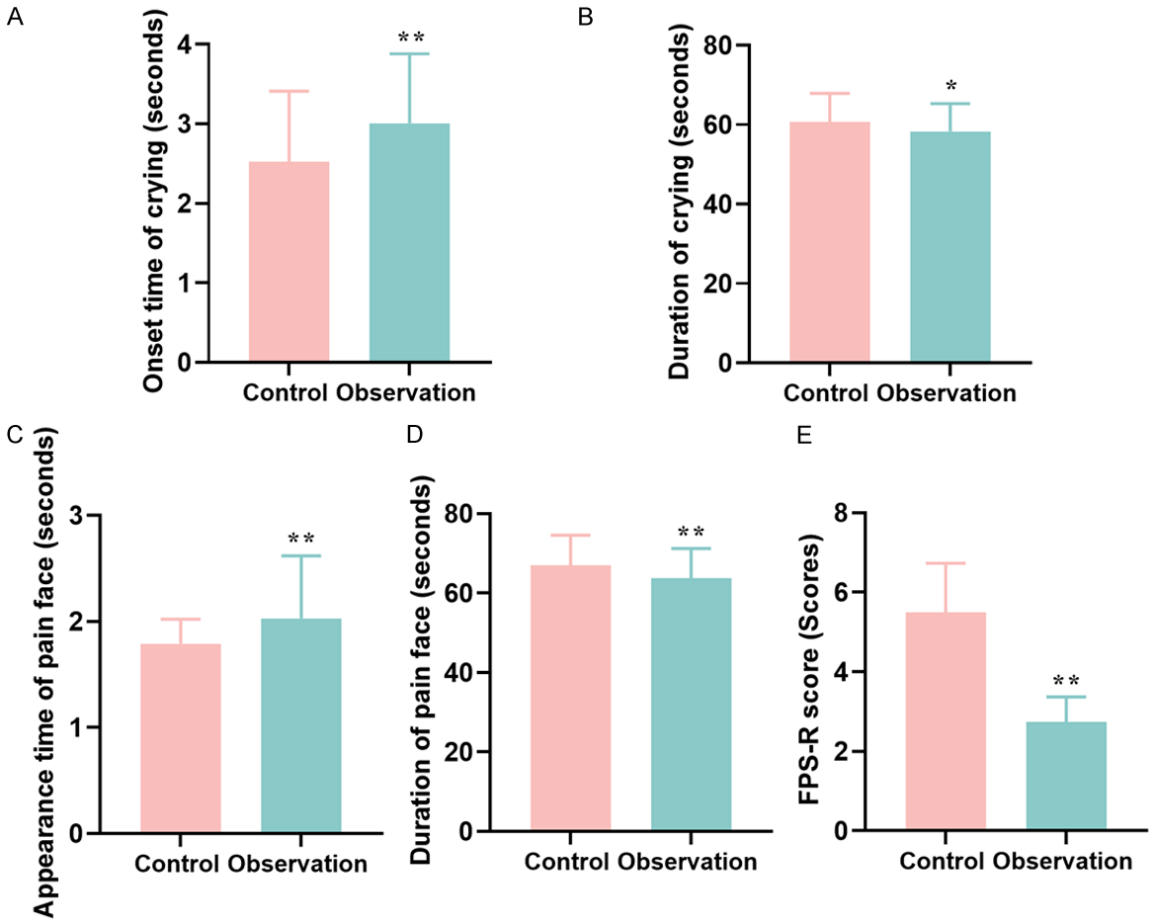

Figure 1. Comparison of pain-related reactions during puncture between the two groups. Note: *: $P<0.05$ vs. control group; **: $P<0.001$ vs. control group.

observation group was significantly higher than that of the control group ($P<0.05$) (**Table 5**).

Multivariable logistic regression analysis

As shown in **Table 6**, after adjusting for covariates, the observation group showed significantly higher odds of one-time successful puncture, painless puncture, and total compliance.

Discussion

Intravenous infusion therapy is a common clinical procedure in pediatric care. It can rapidly alleviate acute symptoms and minimize the adverse effects of common illnesses on children's healthy development [14]. Compared to adult patients, children have more delicate skin and smaller blood vessels, resulting in a significantly lower one-time success rate of venipuncture and poor cooperation. If the first puncture fails, the difficulty of the subsequent attempts increases significantly [15, 16]. Moreover, due to poor systemic tolerance, inappropriate drip rate control can easily cause adverse drug reactions. Moreover, children's poor self-control during infusion makes them prone to tubing kinking and needle dislodgement. These challenges markedly increase the complexity of pediatric intravenous infusion nursing and negatively affect clinical treatment outcomes to some extent [17]. Therefore, additional nursing interventions are needed to enhance children's compliance and promote active cooperation during intravenous infusion. This study found that the application of evidence-based nursing in pediatric intravenous infusion can effectively alleviate pain and stress responses, improve puncture and infusion quality, and enhance children's cooperation and parental medical experience.

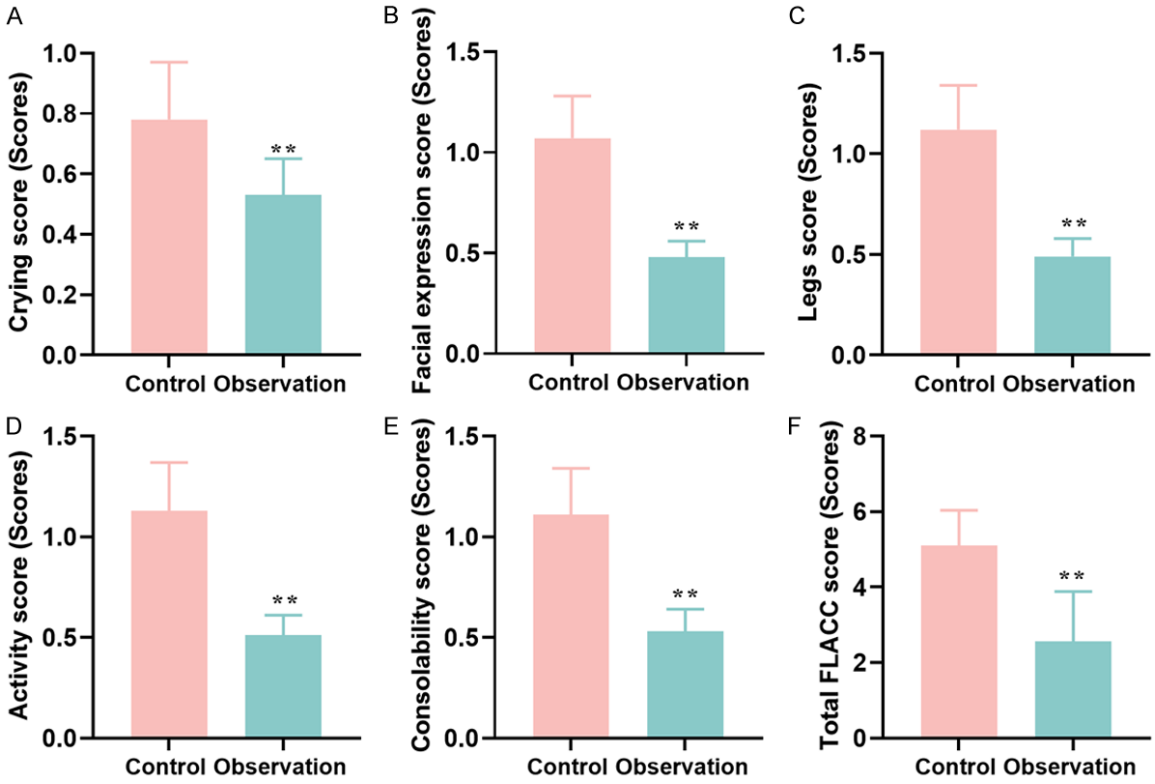

Figure 2. Comparison of FLACC scores between the two groups. Note: **: *P*<0.001 vs. control group.

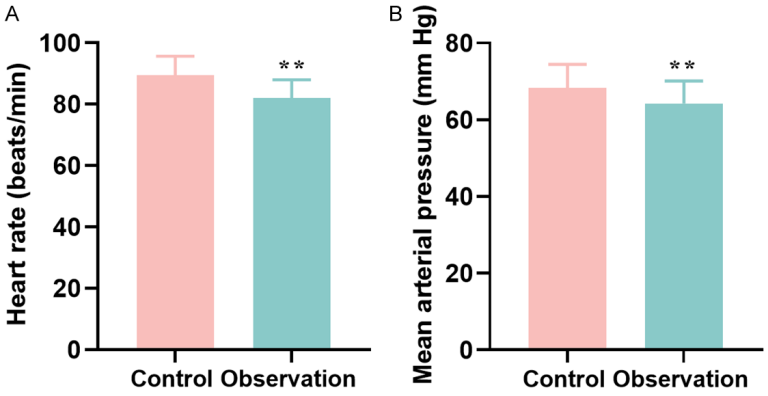

Figure 3. Comparison of stress responses during puncture between the two groups. Note: **: *P*<0.001 vs. control group.

Pain caused by intravenous infusion is a common source of procedural pain in children [18]. Inadequate pain control can induce immediate behavioral responses such as crying and struggling, and may lead to long-term medical fear and reduced adherence [19]. In this study, the observation group showed significant improvement in pain-related behaviors through multidimensional evidence-based nursing measures. Psychologically, encouraging words (e.g., "You are brave") and material rewards before puncture, physical comfort measures (e.g., gently patting the forehead and maintaining soft eye contact) during puncture, and distraction strategies such as playing cartoons effectively reduced children's attention to pain. A systematic review and meta-analysis by Cho et al. confirmed that distraction interventions significantly reduce needle-related pain and distress in children [20]. Environmentally, placing cartoon pictures on walls and creating a warm, welcoming infusion environment helped eliminate children's fear of unfamiliar surroundings, reduce baseline anxiety, and thus increase pain threshold. Operationally, using a cotton swab moistened with 0.9% sodium chloride to wet the tape before removal directly reduced mechanical tearing stimulation to the skin and pain receptors. These measures formed a comprehensive pain management before, during,

Table 2. Comparison of compliance rates between the two groups

Group	Number of cases	Complete compliance	Partial compliance	Non-compliance	Total compliance
Control group	110	36 (32.7)	48 (43.6)	26 (23.6)	84 (76.4)
Observation group	110	52 (47.3)	46 (41.8)	12 (10.9)	98 (89.1)
χ^2 value					6.235
P value					0.013

Table 3. Comparison of puncture quality between the two groups

Group	Number of cases	One-time successful puncture	Painless puncture	Puncture without hematoma	Fixation without loosening	Needle removal without ecchymosis
Control group	110	79 (71.8)	71 (64.5)	103 (93.6)	94 (85.5)	96 (87.3)
Observation group	110	98 (89.1)	85 (77.3)	109 (99.1)	108 (98.2)	105 (95.5)
χ^2 value		10.435	4.319	4.670	11.859	4.666
P value		0.001	0.038	0.031	0.001	0.031

Table 4. Comparison of infusion quality between the two groups

Group	Number of cases	Infusion extravasation	Infusion air embolism	Tubing detachment	Tubing kinking
Control group	110	20 (18.2)	7 (6.4)	9 (8.2)	12 (10.9)
Observation group	110	8 (7.3)	1 (0.9)	2 (1.8)	4 (3.6)
χ^2 value		5.893	4.670	4.689	4.314
P value		0.015	0.031	0.030	0.038

Table 5. Comparison of parent satisfaction with nursing care between the two groups

Group	Number of cases	Very satisfied	Satisfied	Dissatisfied	Total satisfaction
Control group	110	52 (47.3)	37 (33.6)	21 (19.1)	89 (80.9)
Observation group	110	63 (57.3)	41 (37.3)	6 (5.5)	104 (94.5)
χ^2 value					9.499
P value					0.002

Table 6. Multivariable logistic regression analysis of key outcomes

Outcome	Adjusted OR	95% CI	*P* value
One-time successful puncture	2.96	1.58-5.54	0.001
Painless puncture	1.89	1.05-3.40	0.034
Total compliance	2.41	1.15-5.05	0.020

and after puncture, collectively delaying the onset of crying and pain expressions and shortening their duration. In a study of 90 infants aged 1-12 months undergoing peripheral intravenous catheter placement, breastfeeding during venipuncture significantly delayed the onset of crying and shortened total crying time compared to standard care, indicating that distraction effectively reduces pain perception in children [21]. The reduction in each FLACC subscale score further confirmed the analgesic effect of this comprehensive intervention from a behavioral perspective.

Regarding puncture and infusion quality improvement, the one-time successful puncture rate, painless puncture rate, and puncture without hematoma rate in the observation

group were significantly higher than those in the control group. Traditional nursing relies heavily on nurses' personal experience, leading to high operational variability. The evidence-based nursing protocol in this study incorporated improvements in operational techniques: On one hand, nurses were required to perform punctures with "speed, accuracy, and stability", and small-gauge needles were chosen to reduce vessel wall damage; On the other hand, the puncture angle was increased from the traditional 20° to 30°-45°, which reduces the subcutaneous travel distance of the needle tip and decreases mechanical injury, thereby improving success rate and reducing pain [22, 23]. Additionally, daily living care (e.g., avoiding discomfort from fasting during infusion) and posture optimization reduced struggling and resistance caused by hunger and improper positioning. For infusion quality maintenance, the protocol emphasized systematic measures such as increased rounds, monitoring drip rate and needle condition, double-checking during fluid changes, and confirming the child's name, effectively reducing adverse events such as extravasation, tubing detachment, and kinking. Multiple studies have shown that optimized nursing measures and enhanced nursing management significantly reduce pediatric infusion adverse events, which is consistent with our results [24, 25].

Painful stimuli activate the hypothalamic-pituitary-adrenal axis, triggering physiological stress responses such as increased heart rate and blood pressure [26]. In this study, the heart rate and mean arterial pressure of children in the observation group were significantly lower than those of the control group, indicating that evidence-based nursing effectively reduced procedure-induced acute stress. This improvement in physiologic outcomes resulted from multi-component synergy: psychological care reduced anticipatory anxiety, environmental care reduced tension from unfamiliar surroundings, distraction interfered with cognitive processing of pain signals, and optimized puncture technique directly reduced pain input intensity. Tang et al. also found that music intervention during peripherally inserted central catheter placement in preterm infants significantly reduced heart rate and cortisol levels, further supporting the value of non-pharmacologic interventions in reducing procedure-related stress [27]. Moreover, the total compliance rate (89.1% vs. 76.4%) and parent satisfaction rate (94.5% vs. 80.9%) in the observation group were significantly higher than those in the control group. The reasons are as follows: children cried and struggled less due to reduced pain and improved comfort; moreover, nursing staff explained the puncture plan in detail to parents, obtained their cooperation, and instructed them to adjust the child's clothing according to temperature and accompany the child throughout the procedure, which enhanced parents' trust and involvement. In the study by Lv et al., optimized nursing measures reduced the incidence of pediatric infusion adverse events and improved compliance and family satisfaction [23]. Multivariable logistic regression analysis further indicates that the benefits of evidence-based nursing were not fully explained by the measured baseline covariates, lending support to the robustness of the observed associations.

In summary, this study demonstrated the comprehensive advantages of evidence-based nursing in pediatric intravenous infusion, including pain control, stress reduction, quality improvement, and enhanced satisfaction. Compared to empirical conventional nursing, this evidence-based nursing protocol has stronger specificity, reproducibility, and generalizability, providing an important reference for standardized practice of painless intravenous infusion in pediatrics. However, this study has several limitations. First, as a single-center retrospective study, the grouping was based on the actual nursing regimen received rather than random allocation, which may introduce selection bias and confounding factors. Although no significant differences were found in baseline characteristics between the two groups, unmeasured confounders cannot be completely excluded. Second, although we performed multivariable logistic regression to adjust for measured baseline covariates, residual confounding may still exist due to unmeasured factors such as nursing staff qualifications and the severity of the child's condition. Future prospective, multicenter, large-sample randomized controlled trials are needed, along with the development of stratified evidence-based protocols for different age groups, to further optimize the pediatric intravenous infusion pain management system.

Disclosure of conflict of interest

None.

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