

The Impact of an Educational Program Regarding Total Parenteral Nutrition on Infection Indicators in Neonates Admitted to the Neonatal Intensive Care Unit

Abstract

Background: One of the basic care measures for preterm infants is providing nutrition through total parenteral nutrition (TPN) and one of the most important complications of it is infection. Because prevention of nosocomial infections is an important issue for neonate's safety, this study aimed to determine the effects of a continuing medical education (CME) course on TPN for neonatal intensive care unit (NICU) nurses on indicators of infection in newborns. **Materials and Methods:** This quasi-experimental study was conducted on 127 neonates who fulfilled the inclusion criteria. They were selected through simple convenience sampling method at two stages of before and after the CME program. The inclusion criteria were prescription of TPN by the physician and lack of clinical evidences for infection in newborns before the beginning of TPN. Death of the infant during each stage of the study was considered as the exclusion criteria. The data gathering tool was a data record sheet including clinical signs of infection in the infants and their demographic characteristics. Data were analyzed using Chi-square test, Fisher's exact test, and student's *t*-test in SPSS software. **Results:** The results showed the frequency of clinical markers for infection in newborns at the pre-intervention stage ($n = 41$; 65.10%) was significantly less than at the post-intervention stage ($n = 30$; 46.90%) ($p = 0.04$). **Conclusions:** Nursing educational programs on TPN reduce infection rates among neonates in NICUs.

Keywords: Infection, Iran, neonate care, neonatal intensive care unit, neonate, total parenteral nutrition

Introduction

Nosocomial infections have an important role in the neonatal mortality rate in the neonatal intensive care unit (NICU) and also prolong the duration of hospitalization. The incidence rate of nosocomial infections in NICUs in the United State of America ranges from 12% to 26.50%.^[1] This rate has been reported to range from 1.90% to 25% in Iran.^[2] A study conducted in Ardabil, Iran, showed that during an 11-month period, 1795 neonates were hospitalized in the NICU and the incidence rate of nosocomial infections was 3.90%.^[3] The sources of infection generally include personnel's hands and invasive procedures such as intravenous intubation, parenteral nutrition, and endotracheal intubation (mechanical ventilation).^[1] The results of a study showed that the prevalence of septicemia among patients with intravascular catheters was three times that among patients without intravascular catheters.^[4]

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Therefore, prevention and management of nosocomial infections is one of the main responsibilities of NICU nurses; they can take effective steps toward this responsibility through gaining knowledge on infection management methods and performing correct care measures.^[5]

Many neonates admitted to NICUs require total parenteral nutrition (TPN). In TPN, fluids containing the necessary nutrients are administered intravenously. A major complication of TPN is infection;^[6] thus, meticulous nursing care and supervision are essential to a successful TPN.^[5]

Townell *et al.*, in a study in Australian during 2002–2009, reported 780 cases of TPN and 120 cases of septicemia in 111 patients with a prevalence rate of 15.40%.^[4] They found that 8% of intravascular devices (IVDs) were inserted in an inappropriate manner, and standard

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infection preventive strategies, especially regarding intravascular fluids, must be prioritized.^[4]

Wirtschafter *et al.* in a study on 13 NICUs in California, USA, found that improvement of care quality caused a 25% decrease in central venous-related infections.^[7]

The above-mentioned facts show the necessity of the improvement of nursing care quality. The provision of continuing medical education (CME) courses for nurses can be effective in this regard. Considering the CME implementation process in Iran and that, to our knowledge, the outcome of CME has not been evaluated until today, the present study was conducted with the aim to assess the effect of an educational program on TPN on infection indicators in newborns hospitalized in NICUs.

Materials and Methods

This quasi-experimental study was conducted on 127 neonates admitted to the NICU of Al-Zahra Hospital affiliated to the Isfahan University of Medical Sciences, Isfahan, Iran, in two stages of before (January 20, 2015–May 20, 2015; 63 neonates) and after the intervention (June 4, 2015–October 20, 2015; 64 neonates). The sample size was calculated as a minimum of 63 individuals per group (before and after the intervention) by consulting the statistics supervisor and based on statistical formula with 95% confidence interval and 80% test power. The inclusion criteria for the neonates included prescription of TPN by the physician and lack of clinical and paraclinical evidences for infection in subjects before the beginning of TPN. Death of the neonate due to any cause other than infection during the study was considered as the exclusion criteria. The inclusion criteria for the nurses consisted of a minimum of 1 year work experience in the NICU and willingness to participate in the study.

The intervention consisted of a 6-hour workshop including theoretical and empirical educational materials. The content of the workshop included general infection prevention principles such as hand washing and TPN care. The content of the workshop was prepared and its framework was designed by the research team using books and reliable websites. The workshop was executed in Al-Zahra Hospital for NICU nurses based on a predetermined schedule and with the cooperation of the Medical Education Development Research Center of Isfahan University of Medical Sciences. To encourage nurses to participate in the workshop, they were enrolled free of charge and received CME points. Since all the nurses could not participate in the workshop simultaneously on one day, the workshop was executed on two different days one week apart in accordance with the head of the NICU. From the 40 NICU nurses, 37 who had the inclusion criteria participated in the workshop. Pre- and post-test were conducted an hour before the beginning of the workshop and an hour after the workshop, respectively. The neonates were evaluated in terms of clinical indicators

of infection before and after the intervention during the days they received TPN. These indicators consisted of gastrointestinal, respiratory, neurological, and vasomotor symptoms. The presence of one or more symptoms was considered as evidence of the presence of infection based on the diagnosis of a neonatologist. It should be noted that in the present study, the frequency of clinical infection indicators in neonates was considered as a representation of the nurses' performance. Throughout the duration of study, one of the researchers was present at the ward during each shift (morning, evening, or night) in one day.

The data collection tool was the checklist of clinical infection indicators in neonates. This checklist contains items on gastrointestinal (abdominal distension and a minimum of two consecutive instances of lavage or vomiting), respiratory (respiratory distress, apnea, and increased need for oxygen), neurological (hypotonia, reduced sucking reflex, seizures, and lethargy, poor feeding, loss of consciousness, and lethargy), and vasomotor symptoms (consistent increase in body temperature for more than 3 hours to more than 38.50°C, and skin lesions). It also contains neonates' demographic characteristics (age, gender, gestational age, weight at the time of birth, weight at the beginning of the study, time of TPN initiation, number of days of TPN administration, and vascular access procedure). The checklist was completed by one of the researchers based on the neonates' medical records and interviews with the NICU's nurses and neonatologists.

Data were analyzed using descriptive and inferential statistics (Chi-square test, Fisher's exact test, and independent *t*-test) in SPSS software (version 16, SPSS Inc., Chicago, IL, USA). *p* values of less than 0.05 were considered as significant.

Ethical considerations

This study was done after obtaining the approval ethic committee of Isfahan University Of Medical Sciences (No.: 394202) and with written consent of all nurses who participated in the study and also parents of neonates.

Results

In the present study, 63 neonates and 64 neonates were evaluated in terms of clinical infection indicators, respectively, during period TPN administration in the stages of before and after the intervention. Their demographic characteristics are presented in Table 1.

The results showed that one or more clinical infection indicators were observed in 41 (65%) and 30 (46.90%) of the subjects during receiving TPN at the stages of before and after the intervention. Chi-square test showed that this difference was significant ($p = 0.04$). The frequency of the clinical infection indicators in neonates in the two stages of the study are presented in Table 2.

Paired *t*-test showed that mean knowledge score of the nurses regarding TPN after the intervention (91.90) was significantly higher than before the intervention (67.60) ($p < 0.001$).

Discussion

Incidence of bloodstream infections is a recognized PN-related complication, which increases the rate of morbidity and mortality among neonates. Lack of knowledge about nursing standards for infection prevention in nurses, and the lack of implementation of these standards disrupt the planning and execution of the nursing process. No significant difference was found between the two groups of neonates in terms of demographic characteristics. In other words, the two groups were similar in terms of infection risk factors (age, weight at the time of birth, gestational age, number of days of TPN administration, and neonates' age at TPN initiation).

The results showed that frequency of clinical infection indicators in neonates at the stage of before the intervention is 65%. In a retrospective study in Australia, Townell *et al.* reported 120 cases of bloodstream infection (15.40%) from among 780 TPN cases.^[4] In the present study, bloodstream infections were not studied through blood cultures due to ethical limitations and only the clinical indicators of infection were evaluated.

This finding is in agreement with that of study of Townell *et al.* and is indicated that neonatal infection can be prevented through education and implementation of standard guidelines by the treatment team.

Wirtschafter *et al.* conducted a prospective intervention study on 13 NICUs in California. They reported a 25% decrease rate of infection [4.32% before the intervention (January–August 2006) to 3.33% after the intervention (July–December 2007)] in central venous line-related infections as a result of a 5-stage comprehensive and structured intervention program for the improvement of care quality.^[7] Although clinical indicators were studied in the present study, it was found that the frequency of clinical infection indicators in neonates in the post-intervention group was significantly lower than the pre-intervention group. In other words, CME program has resulted in an increase in nursing care quality in TPN administration, and thus, decreased the probability of infection incidence in neonates. Thus, it can be concluded that the results of the present study is in agreement with that of Wirtschafter *et al.* study.

Helder *et al.* studied the effect of hand hygiene education program on the incidence of nosocomial bloodstream infection in a NICU in the Netherlands.^[8] They showed that the prevalence of bloodstream infection in neonates decreased from 44.50% during the 30 months before the intervention to 36.10% during the 18 months after the intervention ($p < 0.001$).^[8] Castello *et al.* studied the effect of the education of infection control principles of PN in pediatric rehabilitation patients on bloodstream infection in the USA.^[9] In this study, the nurses were trained using an educational software program. The results showed that catheter-related bloodstream infection decreased from 26.10 cases to 4.80 cases for every 1000 TPN per day.^[9] In the present study, like the studies by Helder *et al.* and Castello *et al.*, general infection prevention processes in neonates, such as hand hygiene, were included in the CME workshop, which may be effective in the reduction of clinical infection indicators in neonates after the intervention.

Dinc and Erdil studied the effect of using a booklet as a PN educational intervention on changing nurses' performance and preventing catheter-related infection. They reported that the mean score of nursing performance increased from 45.70 before the intervention to 66.50 after the intervention. Moreover, the prevalence of bloodstream infection was significantly lower in the post-intervention group (30%) compared to the pre-intervention group (42.10%).^[10] In

Table 1: Demographic characteristics of the neonates

Characteristics	Before the intervention	After the intervention	<i>p</i>
	Mean (SD)	Mean (SD)	
Age (day)	3.39(1.73)	3.43(1.25)	0.98
Birth Weight (g)	1317.80(486.3)	1303.90(488.9)	0.87
Gestational age	30.59(3.1)	30.61(2.8)	0.97
Age at TPN initiation (day)	2.50(0.7)	3.30(0.9)	0.49
Duration of TPN (day)	8.70(4.9)	8.20(4.3)	0.48

TPN: Total parenteral nutrition

Table 2: Comparison of the frequency of clinical infection indicators in neonates in the two stages of the study

Signs	Classification	Before the intervention (n=63)	After the intervention (n=64)	χ^2	<i>p</i>
		N%	N%		
Respiratory	Respiratory distress	4(6.3)	3(4.7)	-	0.49
	Apnea	11(17.5)	9(14.1)	0.28	0.60
	Increased need for oxygen	16(25.4)	12(18.8)	0.82	0.18
Neurological	Hyptonia and decreased reflexes	1(1.6)	1(1.6)	-	1.00
	Seizure and Malaise	2(3.2)	0	-	0.12
	Poor feeding and decreased consciousness	2(3.2)	0	-	0.12
Gastrointestinal	Abdominal distension	7(11.1)	5(7.8)	0.40	0.52
	Lavage	28(44.4)	21(32.8)	1.81	0.04

the present study, the nurses' performance was not directly evaluated; however, the decrease in the frequency of clinical infection indicators after the educational intervention can be indicative of improved nursing performance.

Although Infection diagnosis criteria include the evaluation of paraclinical indicators, such as complete blood cell count, blood culture, urine culture, and C-reactive protein (CRP) test, and clinical sign and symptoms at in the present study it was not possible to evaluate paraclinical indicator due to ethical principles and economic burden for the family. This was a limitation of the present study.

Conclusion

In the present study, clinical infection indicators were evaluated in the two groups of neonates. No measure was taken for the prevention of infection in the study environment during the study period except the execution of the PN care education workshop. Hence, it can be concluded that nursing CME on TPN care was effective in decreasing the prevalence of clinical infection indicators in neonates in the NICU. This intervention can be implemented without the use of expensive technology or comprehensive programs. Thus, it is recommended that nurses be encouraged to comply with standard infection prevention strategies, especially regarding intravenous fluids and PN-related bloodstream infection management, through suitable educational programs.

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Conflicts of interest

There are no conflicts of interest.

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